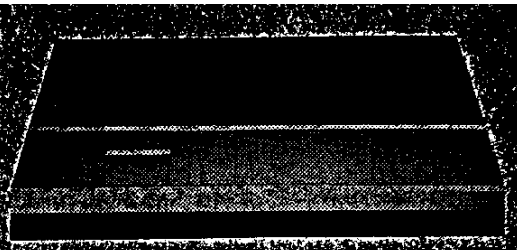
Bang & Olufsen



BEOCORD 5000

TYPE 4715

For Service Manuals
MAURITRON SERVICES
8 Cherry Tree Road, Chinnor
Oxfordshire, OX9 4QY.
Tel (01844) 351694
Fax (01844) 352554
email:- mauritron@dial.pipex.com

SERVICE MANUAL

Bang&Olufsen

INTRODUCTION

The Beocord 5000, type 4715, is a development of the Beocord 5000, type 4705.
This new type uses a combined SENDUST record/playback tape head, resulting in optimum frequency range, signal-to-noise ratio and resistance to wear. Also, it is less critical with regard to differences in tape cassettes than tape recorders with separate record and playback heads.
An additional feature is a circuit for automatic tape-head demagnetization every time a recording is ended.
This service manual is complete, without references to preciously published manuals, and supplementary sheets will be issued only in case of material changes.

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CONTENTS

Circuit diagrams and PC boards 1
Survey of transistors, IC's and diodes 2
Electrical parts list 3
Mechanical parts list 4
Tape head adjustments 5
Mechanical adjustments 6
Electrical adjustments 7
Functional description 8
Technical data 9
Dismantle 10
Service tips and fault finding 11

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Målebetingelser

Alle DC spændinger er målt i forhold til stel, med voltmeter med en indgangsmodstand på 11 Mohm.

Oscillogrammer og AC spændinger er målt i forhold til stel med oscilloscop eller voltmeter med en indgangsmodstand på 1 Mohm.

Spændinger uden parantes: Stilling gengive (333 Hz 25 mm/mm).

Spændinger i parantes: Stilling stop.

AC spændinger opgivet i millivolt (mV). Eks. 733 mV.

DC spændinger opgivet i volt (V). Eks. 0,7 V.

Signalvejen i optage position er vist i højre kanal, og gengive position er vist i venstre kanal.

Measuring conditions

All DC voltages have been measured in relation to ground with voltmeter with an input resistance of 11 Mohms.

Oscillograms and AC voltages have been measured in relation to ground with oscilloscope or voltmeter with an input resistance of 1 Mohm.

Unbracketed voltages: Position play back (333 Hz 25 mm/mm).

Bracketed voltages: Position stop.

AC voltages stated in millivolts (mV). Ex.: 733 mV.

DC voltages stated in volts (V). Ex.: 0.7 V.

The signal path in recording pos. is shown in right channel, and replay position is shown in left channel.

Messbedingungen

Alle DC Spannungen sind im Verhältnis zu Masse gemessen worden, mit Voltmeter mit einem Eingangswiderstand von 11 Mohm.

Oszillogramme und AC Spannungen sind im Verhältnis zu Masse gemessen worden, mit Oszilloskop oder Voltmeter mit einem Eingangswiderstand von 1 Mohm.

Spannungen ohne Klammern: Position Wiedergabe (333 Hz 25 mm/mm).

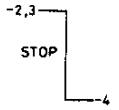
Spannungen in Klammern: Position Stop.

AC Spannungen in Millivolt (mV) aufgegeben, z. B.: 733 mV.

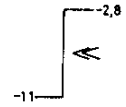
DC Spannungen in Volt (V) aufgegeben, z. B.: 0,7 V.

Der Signalweg in Aufnahmeposition ist in rechten Kanal gezeigt, und die Wiedergabeposition ist in linkem Kanal gezeigt.

Symboler

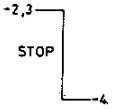


Dette symbol betyder at spændingen springer fra −2,3 V til −4 V når STOP aktiveres.

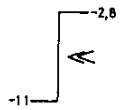


Dette symbol betyder at spændingen springer fra −11 V til −2,8 V når ≪ aktiveres.

Symbols

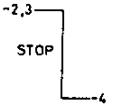


This symbol indicates that the voltage goes from −2,3 V to −4 V when activating panel switch STOP.

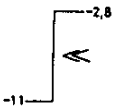


This symbol indicates that the voltage goes from −11 V to −2,8 V when activating panel switch ≪.

Symbole



Dieses Symbol bedeutet, dass die Spannung von −2,3 Volt auf −4 Volt springt, wenn den Panelkontakt STOP aktiviert wird.



Dieses Symbol bedeutet, dass die Spannung von −11 Volt auf −2,8 Volt springt, wenn den Panelkontakt ≪ aktiviert wird.

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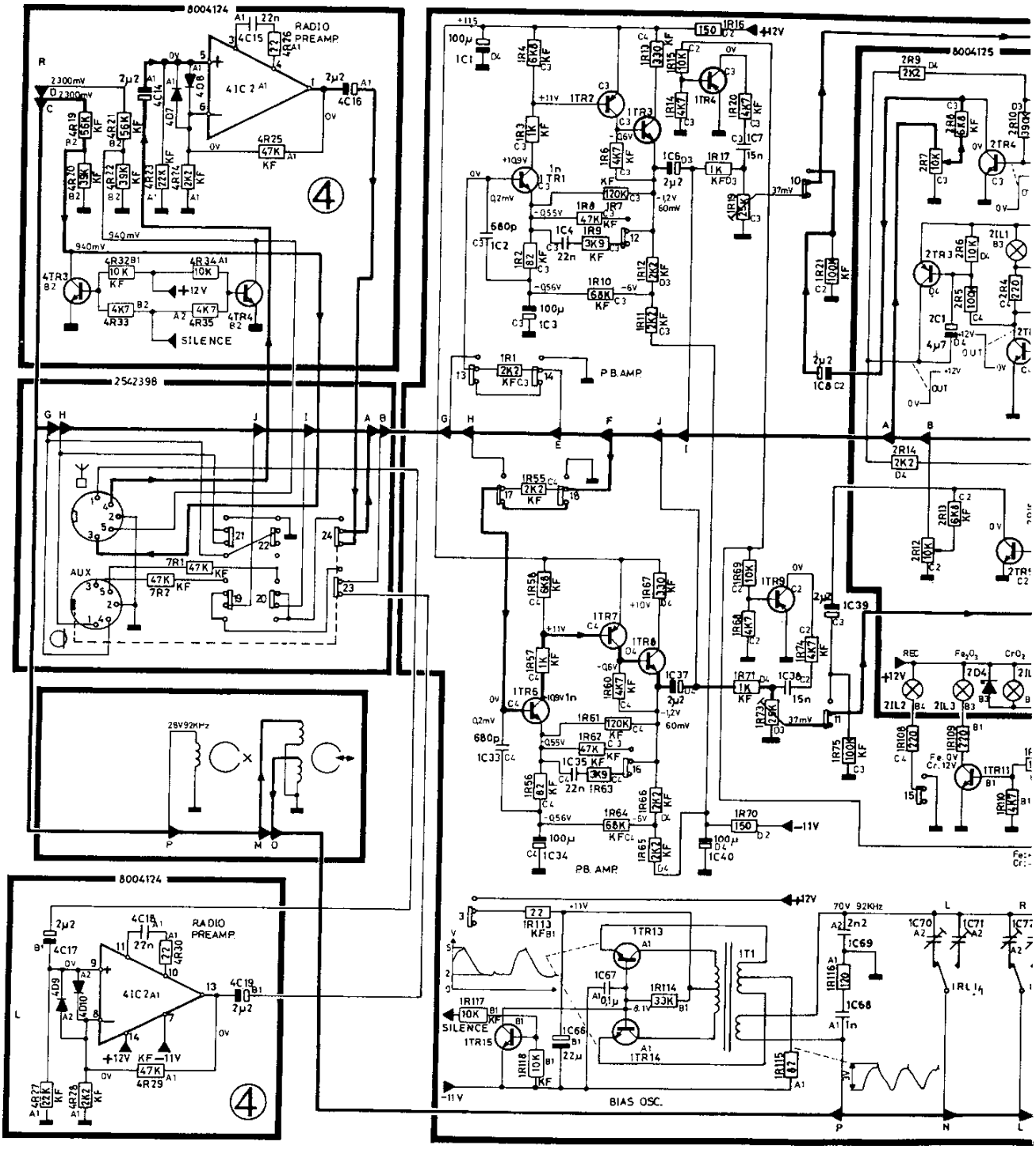
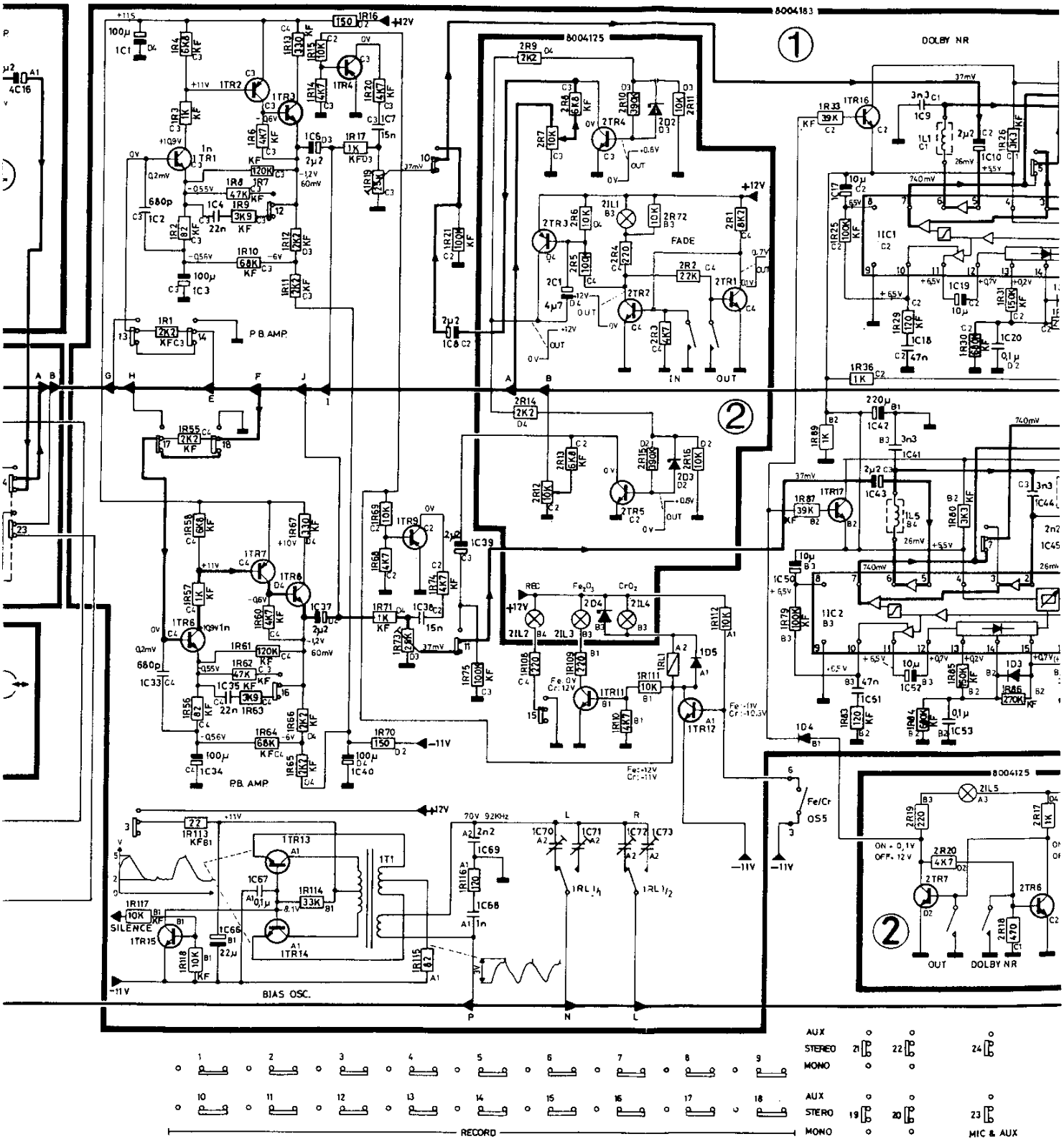
DIAGRAM 1



NOISE REDUCTION CIRCUIT
MADE UNDER LICENSE FROM
DOLBY LABORATORIES INC.


8004183
8004125
8004175
DOLBY NR
FADE
P.B. AMP.
BIAS OSC.
Fe/Cr
OS5
SILENCE
RECORD
AUX
STEREO
MONO
MIC & AUX
OUT
IN

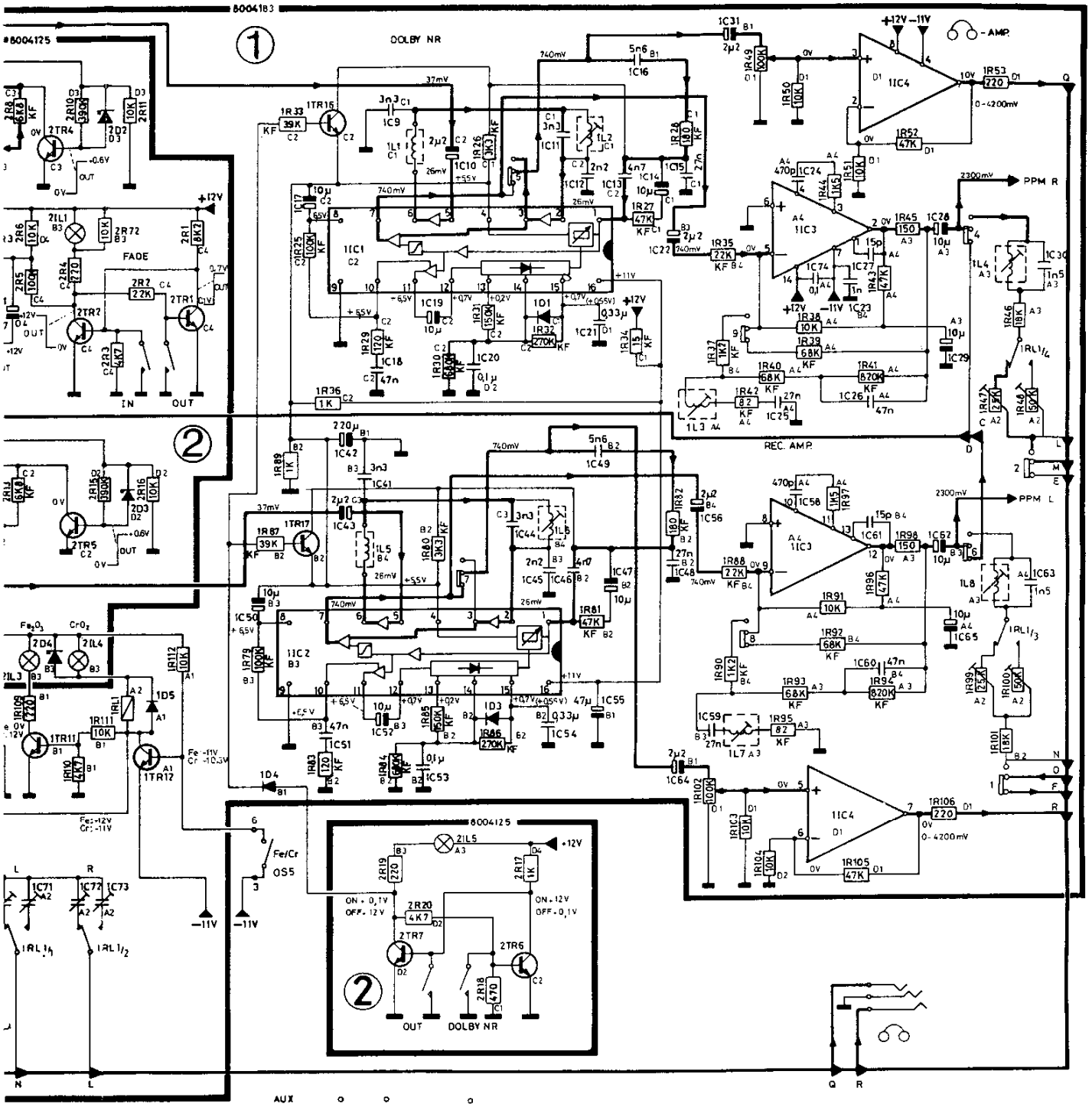


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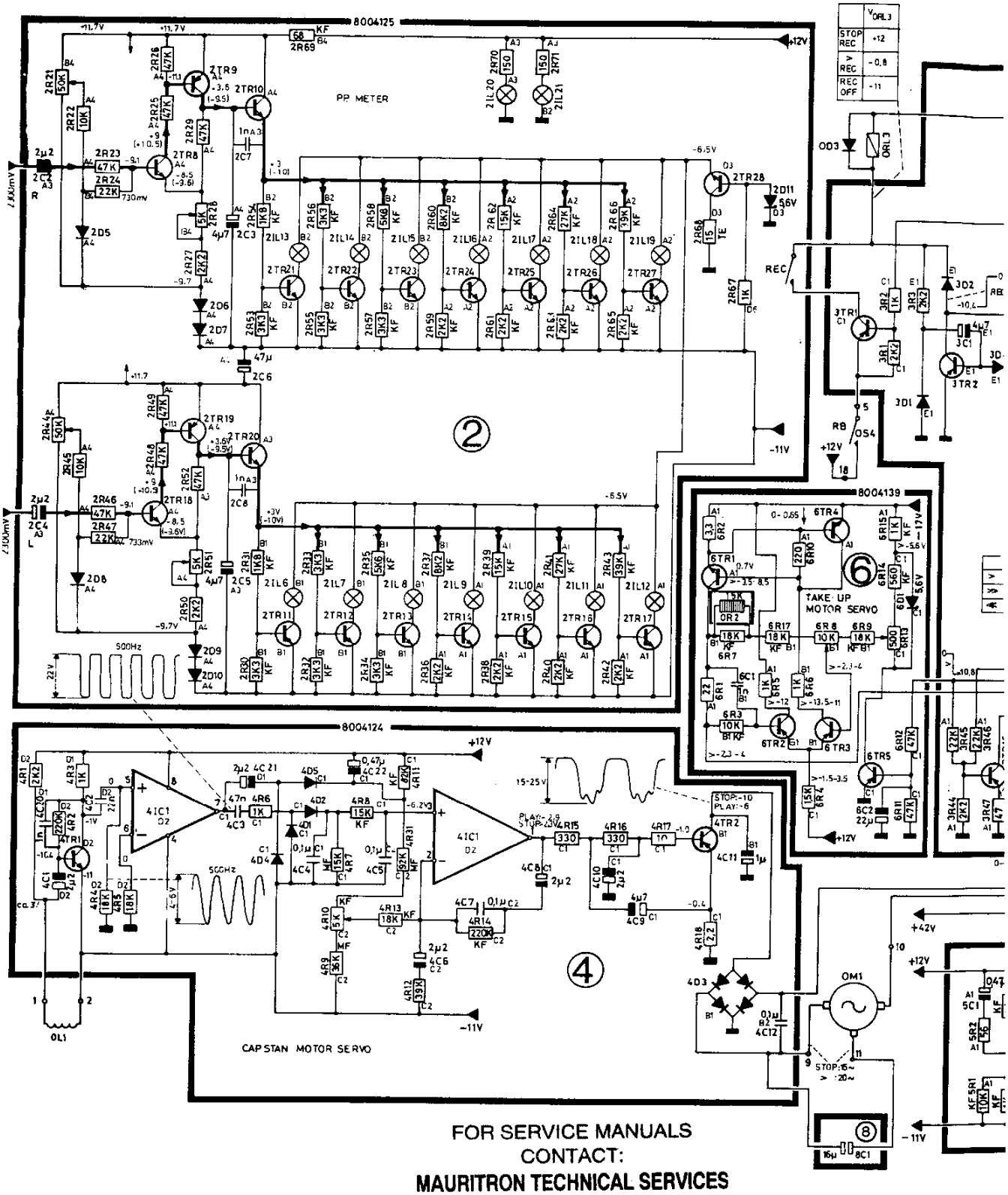
DIAGRAM 2



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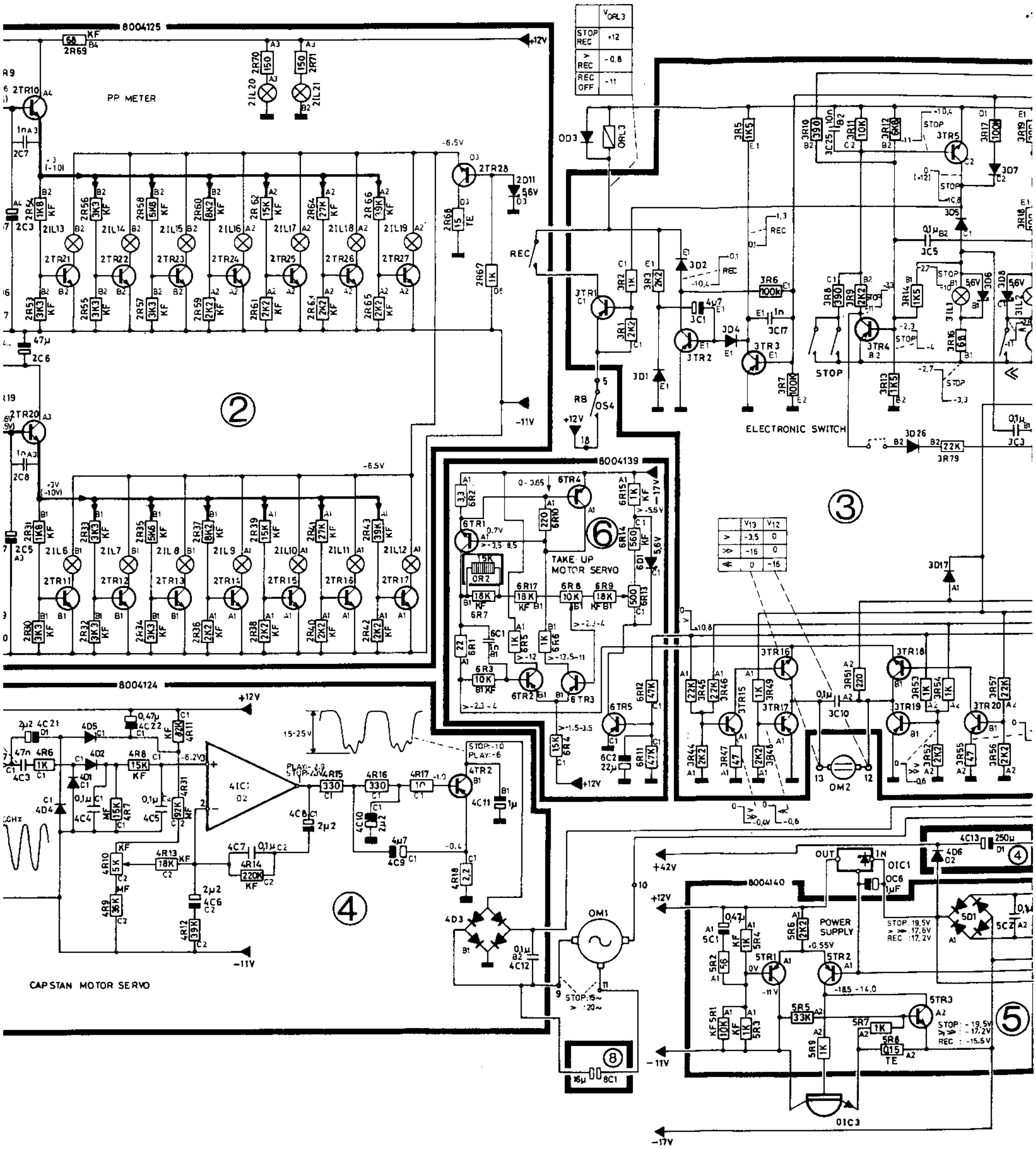
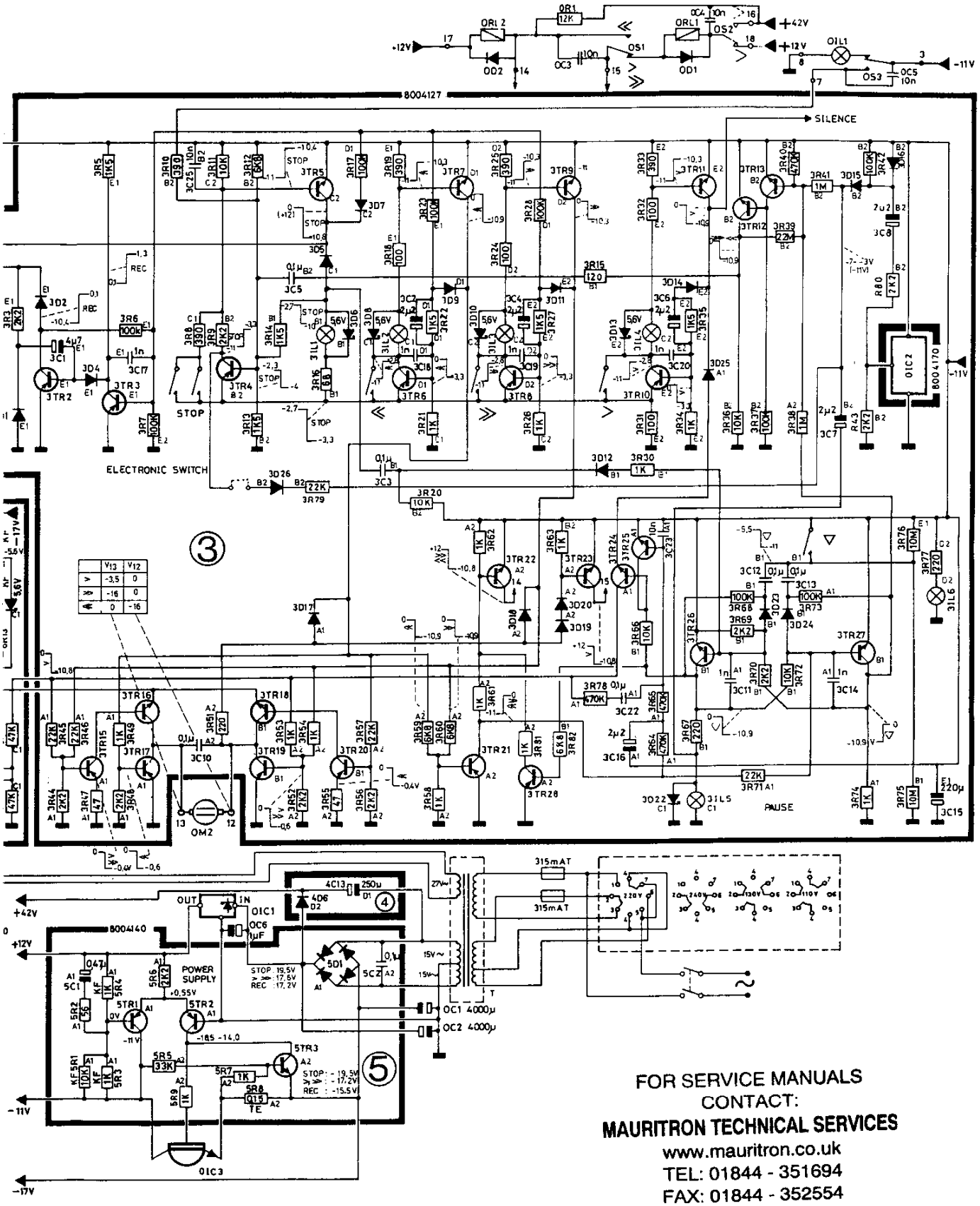

8004125
PP METER
+12V
-11V
-6,5V
ELECTRONIC SWITCH
STOP
REC
8004139
TAKE UP
MOTOR SERVO
8004124
CAPSTAN MOTOR SERVO
STOP: -10
PLAY: -6
15-25V
+42V
+12V
-11V
-17V
8004140
POWER
SUPPLY
STOP: 19,5V
REC: 17,2V
STOP: -19,5V
REC: -15,5V
OM1
OM2
STOP: 15~
OIC1
OIC3
OUT
IN
0C6
1μF

	V_{ORL3}
STOP REC	+12
> REC	-0,8
REC OFF	-11

	V_{13}	V_{12}
>	-3,5	0
>>	-16	0
<<	0	-16



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PC 3, 8004127, Electronic Switch

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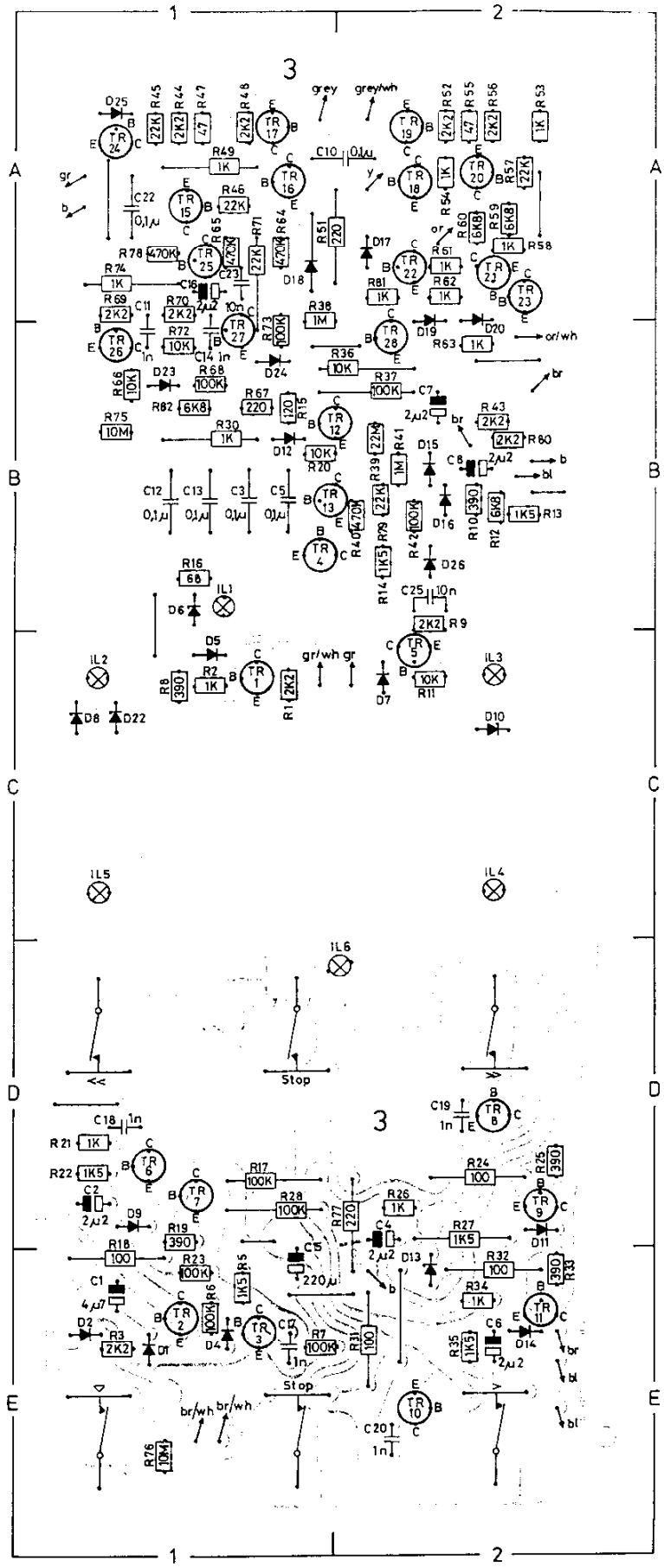

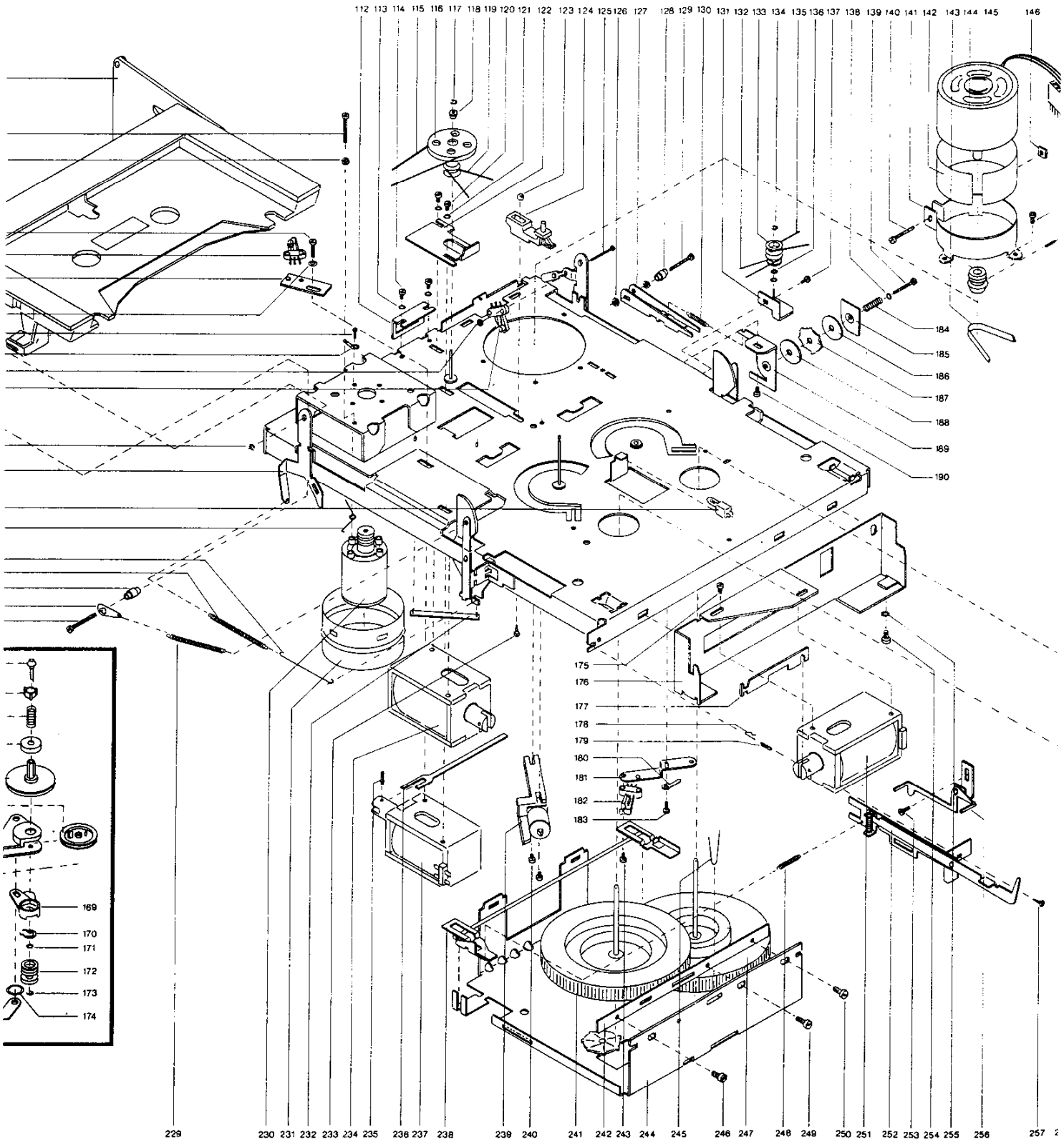
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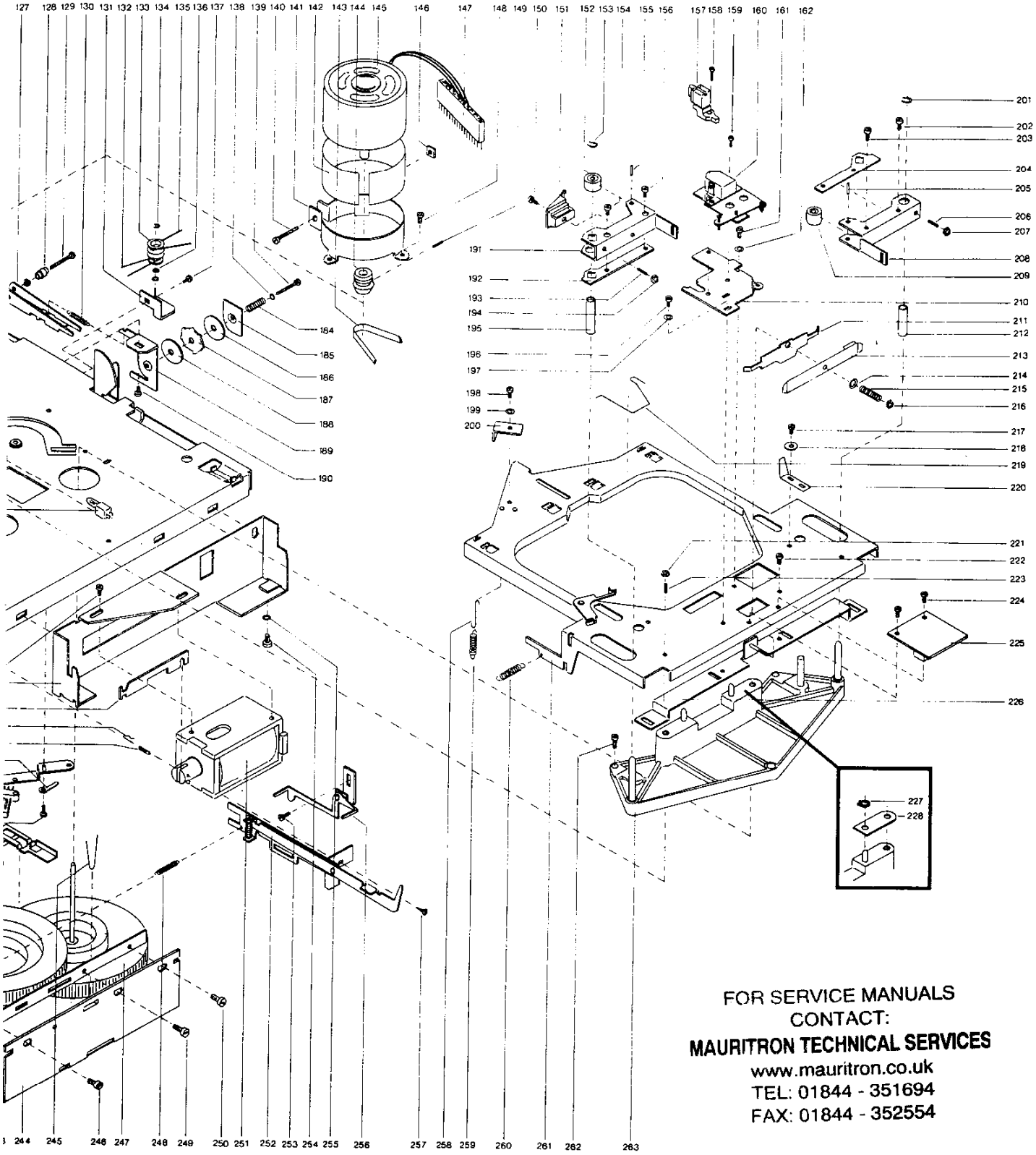

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90	3152151	Cassette holder complete
	2794047	Roller
	3322039	Window
91	2038233	Screw
92	2380011	Nut M3
93	2365076	Hole rivet
94	2038314	Screw
95	7402081	Microswitch
96	3122087	Mounting plate for switch
97	2380011	Nut
98	2622041	Washer
99	2034231	Screw
100	7530008	Solder tag
101	2380011	Nut M3
102	7402081	Microswitch
103	2390004	Seeger circlip
104	3112164	Chassis
105	8230050	Lamp with socket
106	2819139	Spring
107	2850075	Arm
108	2810064	Spring
109	2932075	Bushing
110	2851081	Arm
111	2038227	Screw
112	2530302	Bracket
113	2622041	Washer
114	2038208	Screw
115	2732028	Belt
116	2724043	Cord pulley
117	2390066	Seeger circlip
118	2938098	Bushing
119	2732027	Belt
120	2038208	Screw
121	2622041	Washer
122	2530325	Bracket
123	2917002	Ball
124	3015052	Holder
	3010010	Rubber stop
	2390004	Seegerring
125	2038233	Screw
126	2380011	Nut M3
127	2853035	Arm
128	2932075	Bushing
129	2038237	Screw
130	2810069	Spring
131	2530307	Bracket
132	2732033	Belt
133	2724039	Cord pulley for counter
134	2390066	Seegerring
135	2732033	Belt
136	2622005	Washer
137	2038208	Screw
138	2622041	Washer
139	2038235	Screw
140	2038227	Screw
141	3151123	Holder
142	3302267	Screen
143	2732026	Belt
144	2722021	Belt washer
145	8400089	Motor
146	2380054	Nut
147	7220062	Plug
	8004130	PC unit with socket
	7500076	Pin
148	2038206	Screw
149	2072919	Threaded pin
150	2038206	Screw
151	3015050	Guide piece
152	2804031	Pressure wheel
153	2390005	Seeger circlip
154	2038206	Screw
155	2830071	Bearing needle
156	2038206	Screw
157	8600044	Erase head
	2576096	Spacer
	2033200	Screw
158	2034211	Screw
159	2034039	Screw
160	3124073	Tape head complete
161	2038208	Screw
162	2622041	Washer
163	3164170	Cover
164	2622225	Washer
165	2620066	Felt washer
166	2854037	Arm
167	3152237	Free wheeling left complete
168	3152238	Free wheeling right complete
169	2515027	Arm
170	2390067	Seeger circlip
171	2622005	Washer
172	2724038	Belt washer
173	2390066	Seeger circlip
174	2620066	Felt washer
175	2038208	Screw
176	2542387	Bracket
177	2851073	Arm
178	2819111	Lock
179	2361043	Locking-pin
180	7530008	Solder tag
181	2542408	Mounting plate
182	7402081	Microswitch
183	2038206	Screw
184	2812069	Spring
185	2726006	Washer
186	2622223	Screw, teflon
187	2625021	Tooth-lock washer
188	2622223	Washer, teflon
189	2530299	Bracket
190	2038206	Screw
191	2853031	Pressure wheel arm
192	2560044	Rail
193	2072926	Threaded pin
194	2380011	Nut M3
195	2930062	Bushing
196	2038206	Screw
197	2622041	Washer
198	2038208	Screw
199	2622041	Washer
200	3172071	Insulating piece
201	2390005	Seegerring
202	2038206	Screw
203	2038206	Screw
204	2560044	Rail
205	2830071	Bearing needle
206	2072926	Threaded pin
207	2380011	Nut M3
208	2853031	Pressure wheel arm
209	2804031	Pressure wheel
210	3124057	Mounting plate
211	2570021	Connection piece
212	2930062	Bushing
213	2816129	Spring pad
214	2624027	Washer
215	2812070	Spring
216	2380011	Nut
217	2038206	Screw
218	2622247	Washer
219	2819098	Brake spring
220	2816127	Spring for cassette pad
221	2380011	Nut M3
222	2038208	Screw
223	2072919	Threaded pin
224	2038206	Screw
225	8004137	PC unit with socket
	7220052	Plug
	7500076	Pin
226	2510110	Clamp

227	2390005	Seeger circlip
228	2627008	Washer
229	2810064	Spring
230	8400081	Motor
231	3302238	Screen
232	3152101	Wire holder
233	2013201	Screw
234	6840184	Magnet coil
	2894041	Anchor
235	2361043	Pin
236	2851085	Arm
237	6840184	Magnet coil
	2894041	Anchor
238	2850074	Release arm
239	2542406	Bracket
	6840179	Coil
240	2038208	Screw
241	2794053	Flywheel
242	2560043	Rail
243	2038214	Screw
244	2542397	Bracket
245	2819105	Spring
246	2042244	Screw
247	2794054	Flywheel
248	2810069	Spring
249	2042244	Screw
250	2042244	Screw
251	6840185	Magnet coil
	2894041	Anchor
252	2530305	Release arm
	2038233	Screw
	2812069	Spring
253	2038206	Screw
254	2042244	Screw
255	2625025	Tooth-lock washer
256	2510112	Arm
257	2013075	Screw
258	2850078	Arm
259	2810063	Spring
260	2810063	Spring
261	3112163	Chassis
262	2038214	Screw
263	3114082	Chassis
278	3030027	Hinge
279	2851071	Arm
280	2530296	Bracket
281	2530296	Bracket
282	7450023	Mains switch
283	2810076	Spring
284	3152168	Holder
285	2992055	Contact pin
286	3152068	Holder
287	3164185	Cover
288	3300060	Screen
289	3358027	Heat sink
290	5300089	Potentiometer
291	2794055	Wheel
292	2395006	Spire
293	3152142	Cover
294	7500050	Contact bridge
295	7500075	Contact spring
296	2992051	Contact pin
297	3152068	Holder
298	3370084	Light conductor
299	3152148	Holder
300	3164206	Cover
301	3300058	Screen
302	3300059	Screen
306	2570019	Connection piece
307	7410007	Switch
308	7410007	Switch
309	7212021	Jack-socket
310	2622226	Washer
311	2380092	Nut
312	2542398	Bracket mounted
313	2834039	Shaft

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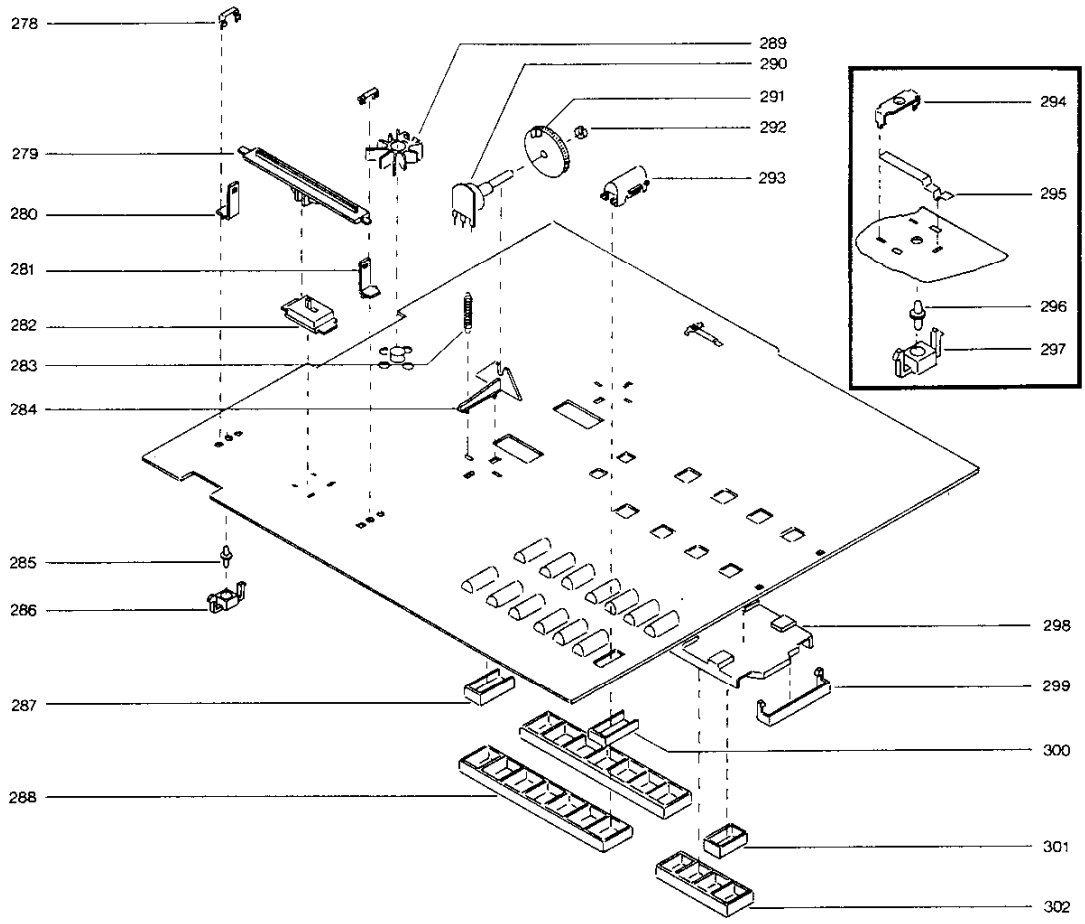
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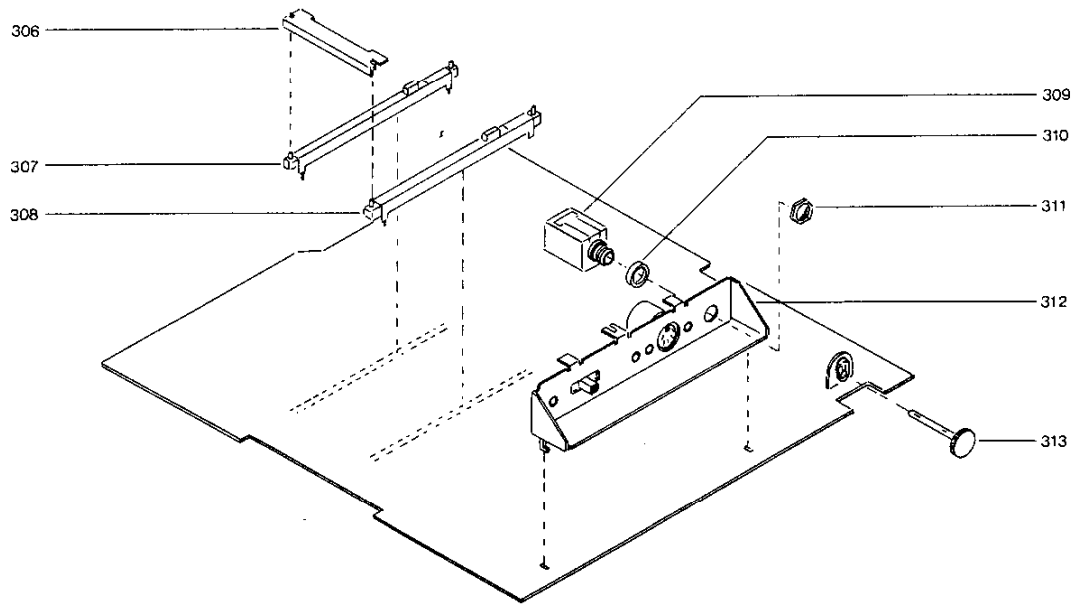
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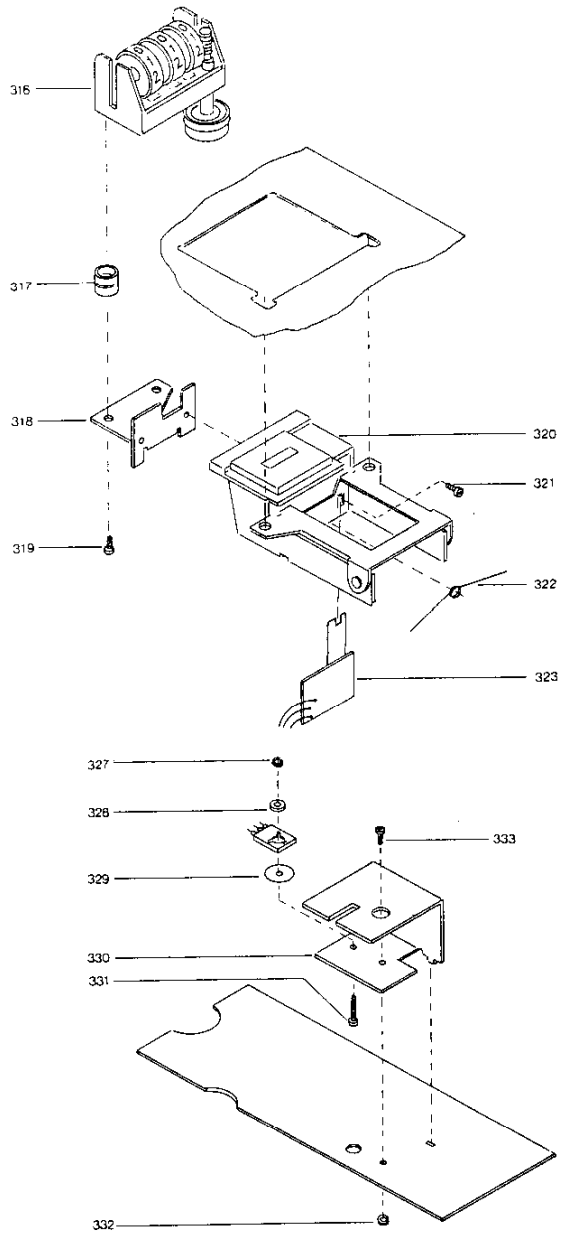
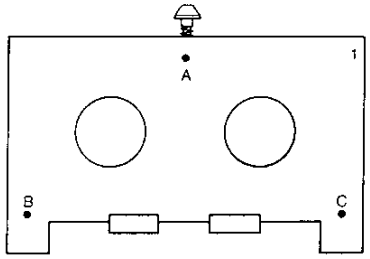


316 3370120 Counter
317 2938023 Bushing
318 2530340 Bracket
319 2038017 Screw
320 2775418 Knob for counter
321 2038951 Screw
322 2819108 Spring
323 8004170 PC unit
327 2380011 Nut
328 2624013 Washer
329 2622231 Mica sheet
330 3358093 Heat sink
331 2038216 Screw
332 2380011 Nut
333 2038247 Screw

Parts not shown

6271102 Mains lead
6271094 Signal lead
3534159 Instruction diagram
3391451 Outer carton
3397224 Foam packing right
3397225 Foam packing left
3100013 Repair stand
2938128 Transport protection device
3946017 Plastic foil (40 X 100 cm) for packing
6270186 Interconnecting cable kit for repair
6780041 Service cassette kit
3624020 Adjustment tools (tapehead)

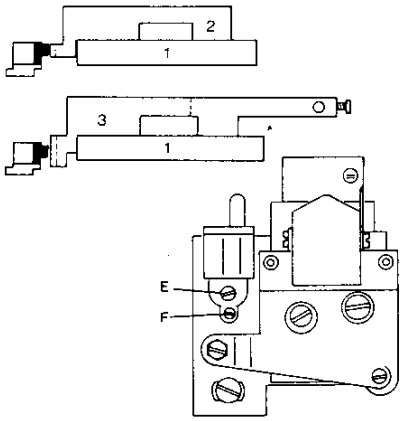
TAPE HEAD ADJ.
Adjustment tools

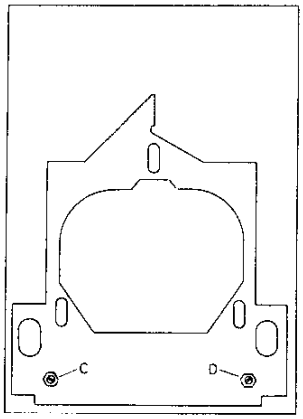


The starting point for the adjustment tools is point A, B and C. The tools should be placed on these points; this will provide a fixed reference relative to the tape mechanism.
Tape head adjustments can be made ONLY with the tools prescribed.
Before adjusting the tapeheads be sure that the tape mechanism is correctly fastened in the chassis.

Height, erase head

Loosen screw E and with screw F adjust so that a visual impression is received of the erase head as being in zenith (forward/backward).
Tighten screw E.
Loosen lock nuts at screws C and D
With screws C and D adjust so that erase head is level with adjustment tool No. 2.

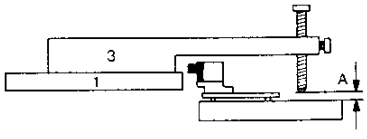


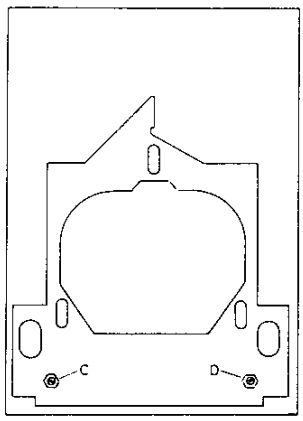


Zenith, erase head

Loosen screw E, and with screw F adjust while observing air gap to zenith to tool No. 3
Tighten screw E.

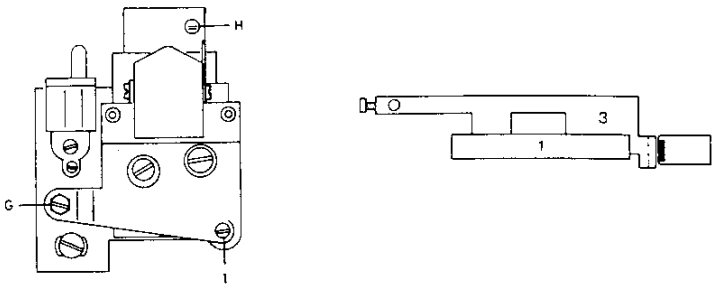
Tape head parallelism





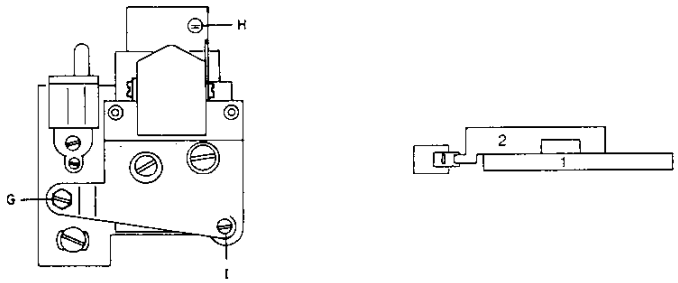
Adjust tape head bridge so that distance A (from tool to tape head bridge) is the same in the right and left sides. Adjust with screws C and D. Check height and zenith of erase head and tighten lock nuts at C and D.

Zenith, combi head



To adjust screws H and I, first heat the screw heads for 10 – 30 sec. With a 100 W soldering iron. Unscrew the screws and fit new screws. After having made the adjustments, lock screws H and I with IS 12 (see page 11-2).
Zenith is adjusted with screw I while observing the light gap until adjustment tool No. 3 abuts against the face of the playback head.

Height, combi head



Place adjustment tool No. 1 and 2 in cassette holder. Press tape head bridge into adjustment tool. Adjust the combi head with screws G, H and I (turning all of them in the same direction) until the lower tape guide of the recording head only just touches the lower edge of the adjustment tool.

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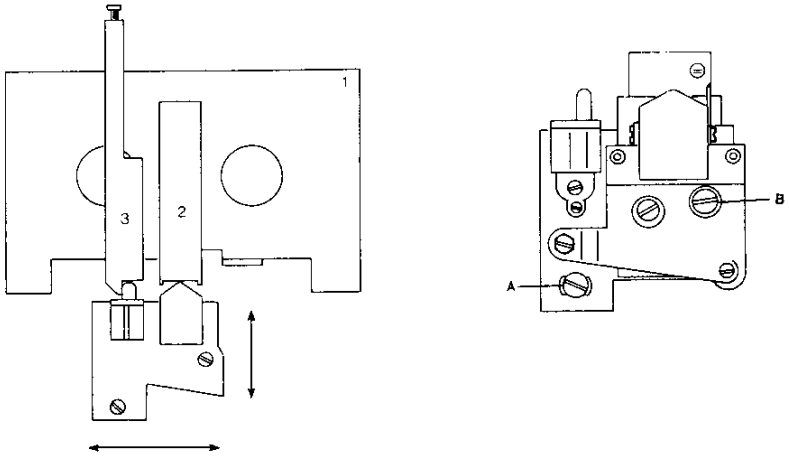
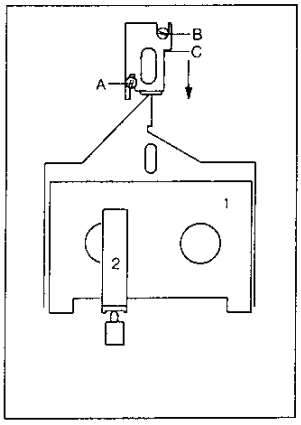
Sideways adjustment of tape head arrangement



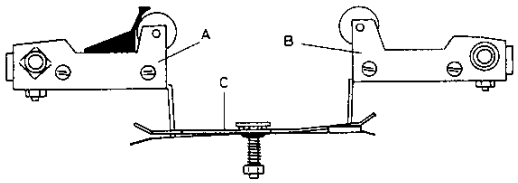
Place adjustment tools 1, 2 and 3 in the cassette holder so that tool 3 abuts against tool 1 down over the cassette guide in the tape transporting mechanism, and tool 2 opposite the combi head. Loosen screws A and B. Push the tape head bridge forwards until the erase head reaches in to adjustment tool 1 and the combihead into tool 2.
Push the tape head system in the direction of the arrows until the erase head abuts against the angle on tool 3.

Insertion depth

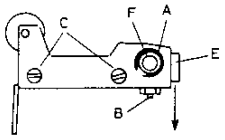


Insertion for normal forward tape travel: Place adjustment tools 1 and 2 in the cassette holder so that tool 2 abuts against tool 1 opposite the erase head.
Loosen screws A and B.
While holding the tape head bridge, activate normal forward tape travel.
Thereafter shift the magnet coil until the mirror on the erase head just reaches into the adjustment tool. Tighten screw B. Push angle C in the direction of the arrow as far as possible and tighten screw A.
Check height and zenith on the combi head.

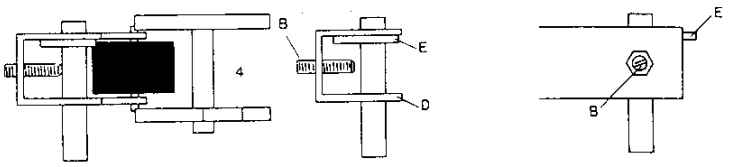
Thrust roller parallelism



Release thrust roller arms A and B from arm C.
Release arm A first on account of the tape guide.
When inserting the thrust roller arms on arm C, insert arm B first, likewise on account of the tape guide.



Remove locking ring A.
Loosen screw B.
Loosen screws C.
Mount adjustment tool No. 3 on capstan shaft.



Press thrust roller arm (at point D) and arm E in direction of arrow. Press thrust roller arm into the notches on the tool; first tighten screws C lightly.
Take off thrust roller arm; screws C can now be tightened fully.
Take off the tool, mount thrust roller arm and put on locking ring A.
Adjustment procedures for right and left thrust roller arms are identical.

Height, left-hand thrust roller

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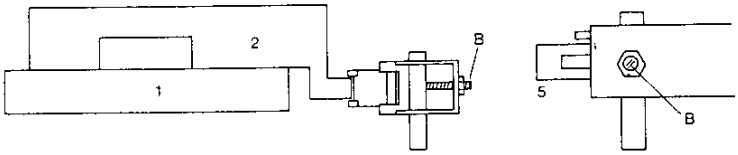
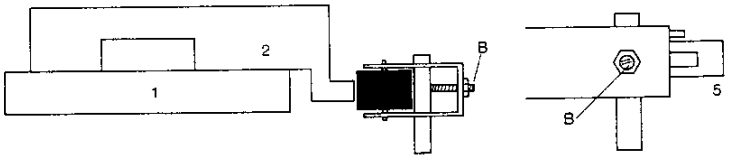


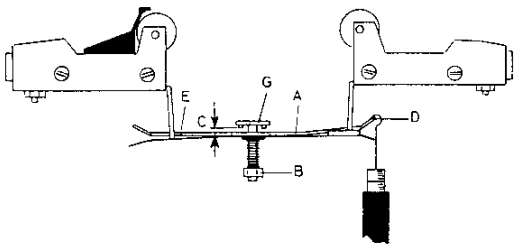
Mount tool No. 5 on thrust roller arm.
Slide thrust roller arm up and down until adjustment tool No. 2 fits into middle of thrust roller.
With care, tighten pointed screw B and the lock nut.

Height, right-hand thrust roller



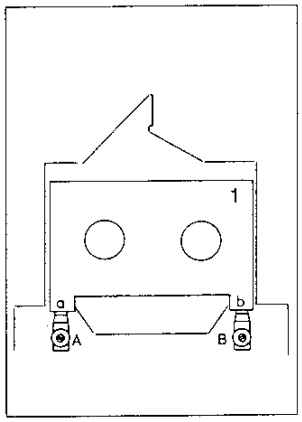
Mount tool No. 5 on thrust roller arm.
Slide thrust roller arm up and down until adjustment tool No. 2 is opposite middle of thrust roller.
With care, tighten pointed screw B and the lock nut.

Thrust-roller pressure



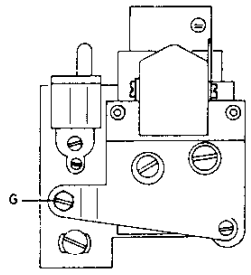
Set tape recorder to "Play". With a No. 3342007 spring balance at point D pull the thrust roller arm clear of the capstan shaft. Now release the thrust roller arm until it only just touches the capstan shaft. The spring balance should now read 400 p. Adjust with nut B.
Check, by pushing the tape head bridge in, that the right-hand thrust roller reaches the capstan shaft before the left-hand thrust roller does.
Adjustment can be carried out by bending the arm A at the point E so that the clearance between the stud on angle G and arm A is approx. 0.4 mm at point C.
Recheck thrust roller pressure.
After having adjusted the thrust roller pressure, check the insertion depth.

Spring pressure on cassette



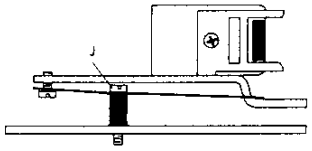
Place adjustment tool No. 1 in cassette holder.
Push tape head bridge forward into "Play" position.
Loosen screws A and B. Adjust springs so that they only just touch tags a and b on the adjustment tool.
Tighten screws A and B.

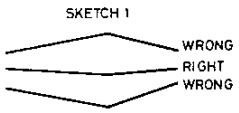
Azimuth



Demagnetise tape heads and erase head.
Place azimuth tape No. 6780036 in cassette holder.
Connect the two Y-inputs of an oscilloscope to right and left channels at the tape recorder output, respectively.
Push "Play" button.
With screw G adjust for inphase relations of the two curves on the oscilloscope at max. amplitude.
Check height and zenith.
Check playback and record/playback frequency response.

Leaf spring





After adjustments to the tape head arrangement check to see that the leaf spring under the playback head is correctly tightened.
(Screw J should be screwed home, with care).

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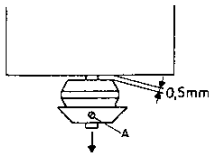
MECHANICAL ADJUSTMENT

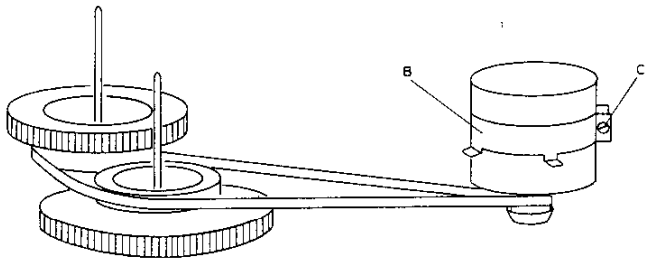
On account of the construction of the Beocord 5000 it is important that mechanical adjustments be carried out in the sequence described here. Also, it is assumed that the tape head adjustments are in order before any mechanical adjustments are made.

Motor belt pulley



Loosen pointed screw A.
With motor armature in top position (direction of arrow) adjust clearance between motor housing and belt pulley to approx. 0.5 mm.
Tighten pointed screw A.

Drive belt height



Loosen clamp B by turning screw C.
Push motor housing up or down until the belt is equally spaced from the rims of both flywheels.
Tighten clamp B.
Adjustment is most easily done with the transport mechanism running.

Pickup coil

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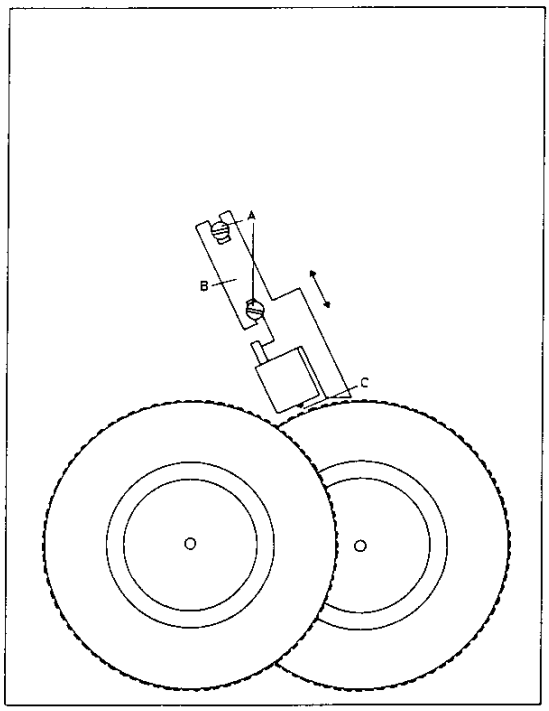
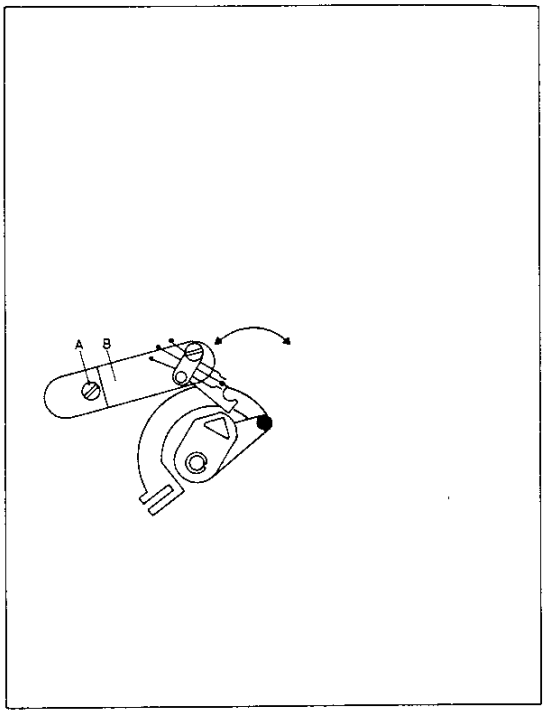


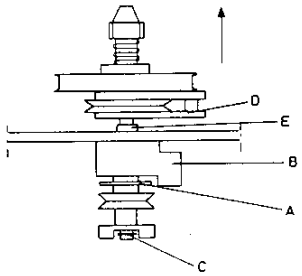
Loosen screws A.
Push B in one of the directions of the arrow until spacing C (from "core" of pickup coil to serration on the flywheel) is approx. 0.5 mm.

Switch for magnet coil



Set free-wheeling mechanism to "Play".
Loosen screw A and turn angle B in direction of arrow until switch only just operates, thereafter turn it approx. 0.5. mm further to ensure that the switch will stay closed even if the free-wheeling mechanism turns backwards slightly.

Free-wheeling, right



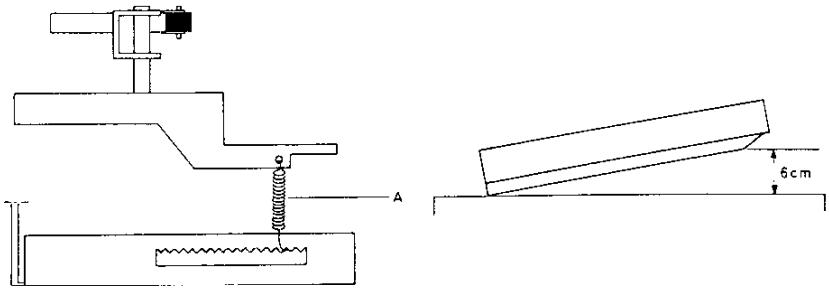
Adjust locking ring A so that clearance exists all the way round between the locking ring and arm B.
Adjust locking rings C so that approx. 0.3 mm clearance exists between holder D and bearing E when the free-wheeling mechanism is pulled in direction of arrow.

The locking rings C should be handled with great care as their spring power is easily weakened.

Bottom bearing

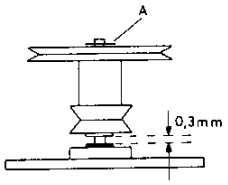
Turn the bottom bearing under the left-hand flywheel so that no clearance exists between bottom bearing and flywheel: thereafter turn bottom bearing back 2 notches.

Tape-head-bridge pull-off



Raise front edge of tape recorder 6 cm relative to rear edge. Push "Fast forward" or "Rewind" button. When the "stop" button is thereafter pushed, the tape head bridge should only just retract fully.
Adjustment can be made by shifting spring A in the notches on the tape mechanism.
Adjustment can be made in both sides, left and right, but the springs should be shifted by equal amounts in both sides.

Clearance, cord pulley



Mount locking ring A so that approx. 0.3 mm clearance exists as shown in sketch.

Brake springs

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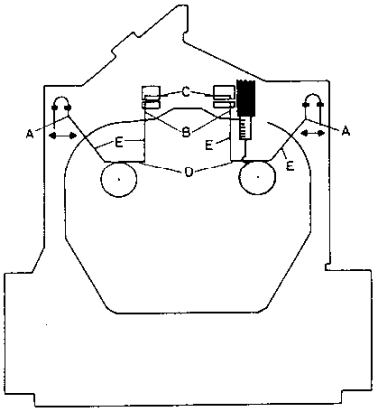
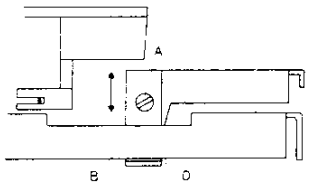
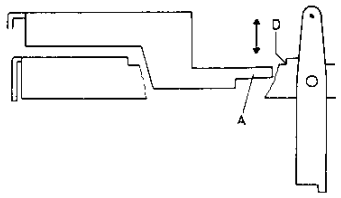


Bend the brake springs at points E until the springs are level with the belt pulley faces of the turntables.
At points A, B and C bend carefully so as to cancel friction between springs and chassis.
Push "Stop" button.
With spring balance No. 3342006 measure at points D.
Weight should be 12 p when springs only just release the belt pulleys.
Adjustment can be made by carefully bending the springs at points A in the direction of the arrows.

Tape-head-bridge clearance

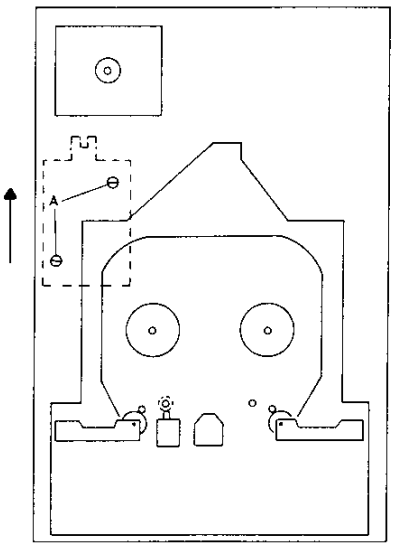


Clearnce in left side:
Loosen screw A.
Shift angle B in one of the directions of the arrow until a small amount of clearnce (approx. 0.1 mm) exists at point D (spacing between angle B and chassis).



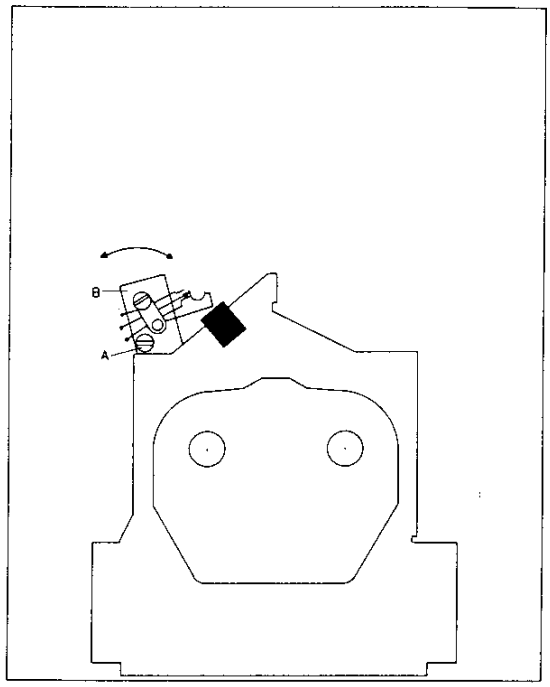
Clearnce in right-hand side:
Bend tag A in one of the directions of the arrow until clearance at point D is approx. 0.2 mm.

Brake magnet coil



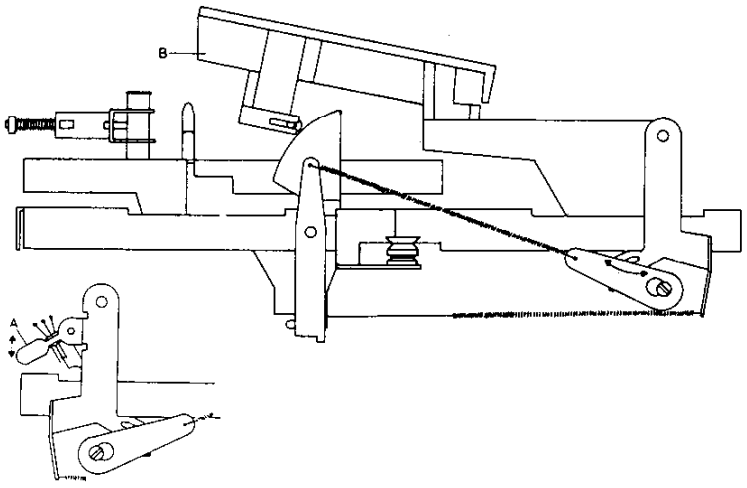
Loosen screws A and push magnet coil in direction of arrow.
Mount teflon bushing from adjustmenttool on left-hand cassette guide.
Push "Fast forward" or "Rewind" button.
Shift brake magnet coil until erase head only just reaches in to the teflon bushing.
Tighten screws A.

Brake coil switch



Loosen screw A.
Push "Play" button.
Turn angle B in direction of arrow until switch only just operates, then turn it approx. 0.5 mm further to ensure that switch will stay closed.
Tighten screw A.

Microswitch for light



Bend arm A in one of the directions of the arrow until the lamp only just lights when the cassette holder is pressed down so that the tops of the capstan shafts are level with point B on the cassette holder.

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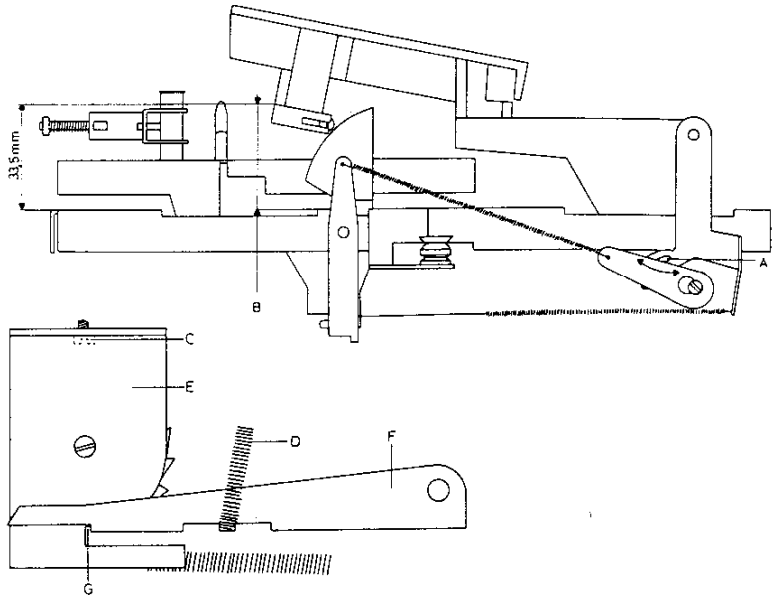
Height cassette holder



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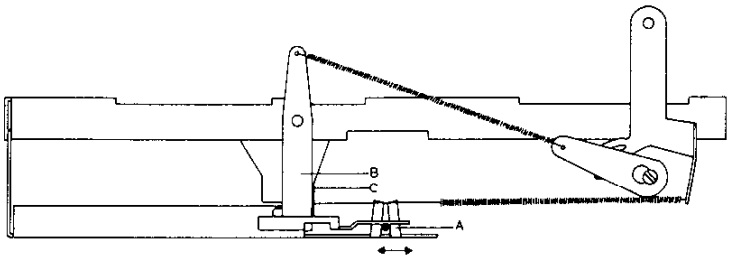
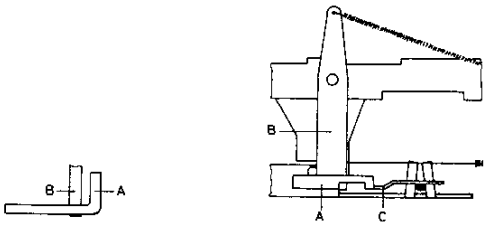
Adjustment is performed with the cassette holder open.
Remove spring D, loosen screw C, and push angle in direction of arrow.
Adjust, by bending tag A, the distance B to be 33.5 mm.
Adjust facilities are provided at both sides of the instrument. The tag A is bent by means of a large screwdriver which is placed in the slot and turned in one of the directions of the arrow.
Adjust angle E so that distance G is approx. 0.5 mm.
Tighten screw C and mount spring D.

Eject

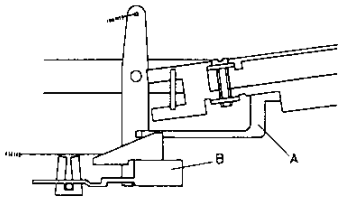


Eject adjustments must be carried out with a cassette in the cassette holder.
Bend arm A in one of the directions of the arrow until the spacing between the arm on the brass piece B and the cassette holder arm C is approx. 0.5 mm (cassette holder closed).
Make this adjustment in both sides, right and left.



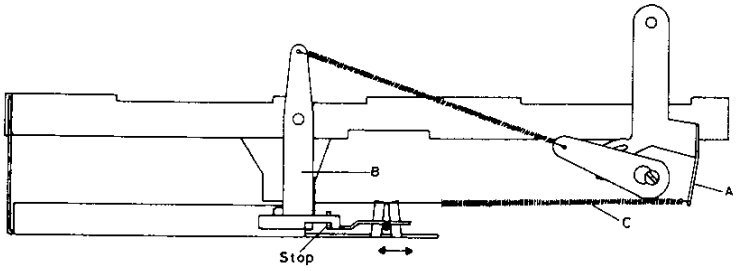
Adjust arm A for parallelism both right and left (horizontal plane). Bend arms at point C so that they reach up to the brass arm B simultaneously in both sides.

Eject release mechanism



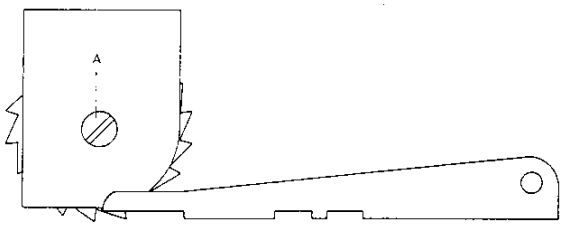
The tape head bridge must be in the neutral position.
Bend arm A so that it only just touches, but does not press, arm B.

Cassette lock



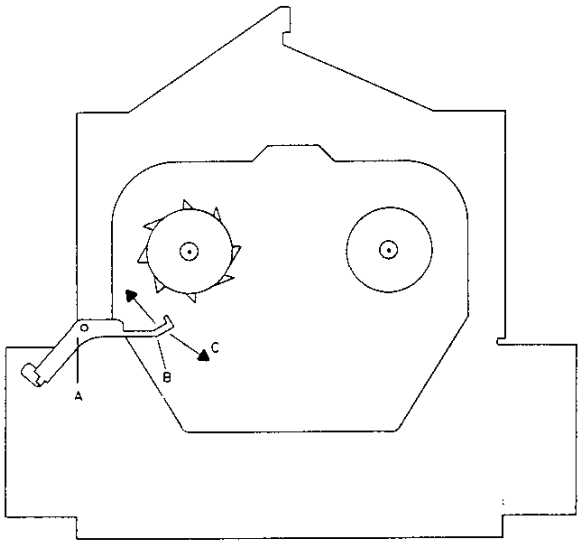
Make this adjustment with a cassette in the holder.
Hold the cassette and holder down in the locked position and release the eject mechanism; thereafter very slowly let go your hold on the cassette.
Brass arm B should the slide against the stop; if it does not, spring C can be tightened by bending arm A. Only tighten spring C so much that arm B only just goes against the stop. Adjustment must be made in both sides of the tape mechanism (arm B have to go easy).

Friction disc -
Cassette holder lifting speed



Adjust screw A until cassette holder lifts at desired speed.
Check:
Cassette in cassette holder.
Hold the cassette and holder down i locked position. Activate the eject mechanism, let go your hold on the eject arm and let go your hold on the cassette. The eject mechanism should then release correctly and lock again when cassette holder is pressed down.

Brake arm for left-hand turntable



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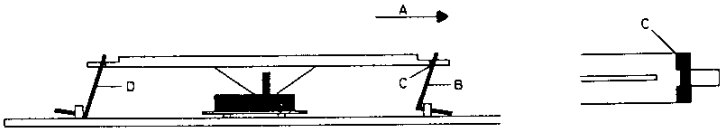
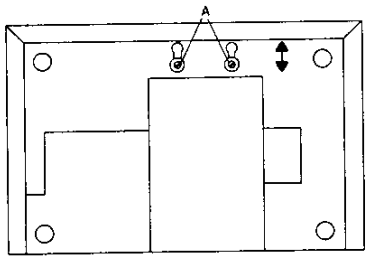
Press armature of brake magnet coil home (tape head bridge in fast forward or re-wind position).
Bend arm A in the directions of arrow C so that arm A only just clears the notches on the supply reel.
Similarly bend arm A at point B in the horizontal plane so that arm A positively grips the notches on the supply reel when the tape head bridge is pushed forward in the "Play" mode.

On/off switch



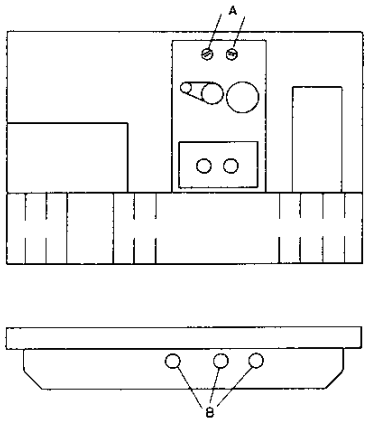
Push the on/off switch in the direction of arrow A to its end position and bend arm B for min. clearance at point C.
Make the same adjustment on arm D at the other end position of the on/off switch.

Placement of tape mechanism: Forwards and backwards



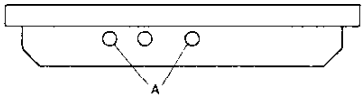
Mount control panel.
Loosen screws A and push tape mechanism in directions of arrow until clearance between control panel and cassette holder is approx. 1 mm.
Tighten screws A.

Sideways



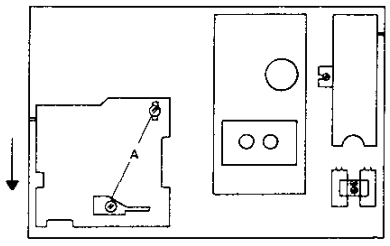
Loosen screws A and B. Screws B are located in the front edge of the tape mechanism and are accessible through the holes in the chassis.
Put the cover plate in place and push the tape mechanism sideways until it is in the middle of the cover plate cutout.
Tighten screws A and B.

Up and down



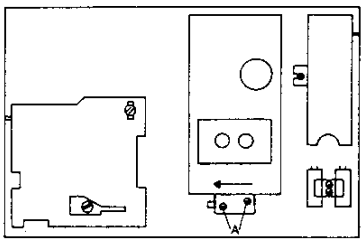
Cassette in cassette holder.
Loosen screws A in front edge of tape mechanism and shift tape mechanism up or down until front edge of cassette holder is approx. 0.5 mm below upper edge of cover plate.
Tighten screws A.

PC board 1



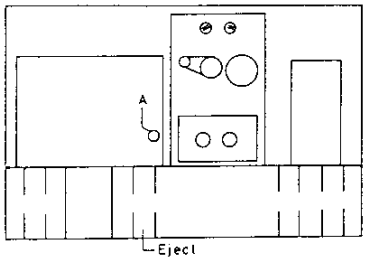
When mounting PC board 1, press PC board against bottom and push it as far as possible in direction of arrow before tightening screws A.

RECORD magnet coil



PC board 1 and the tape mechanism must be securely fastened.
Loosen screws A, press magnet coil armature home and shift magnet coil in direktion of arrow until RECORD switch goes against the stop.
Tighten screws A.

Eject release arm



The control panel must be securely fastened.
Adjust screw A (screw on eject release arm) through hole in PC board 1 until eject mechanism/releases positively when "Eject" button is pressed.

Lubrication chart

The need for relubrication is negligible, but the following directions should be followed for overhauls and when replacing major components.

	Lubricate with
Belt pulley 116: Slide face against shaft Capstan shaft bearings (top) Brake discs 167 and 168: Slide faces against shafts Holders in free running system: Slide faces against brake discs *Bearing pins 155 and 205: Slide faces against thrust rollers. Disc 136 and slide faces been circlip 134 and cord pulley 133. Thrust roller arms 191 and 208: Slide faces against spring holder 213 and connecting piece 211. Shafts on chassis 263: Slide faces against bushings 195 and 212. Rivet joint in arm 256.	3984007 Shell Tellus T 72--73 Shell Vitrea 72--73 (small amount)
Ball 123: Holder for ball	3984005 Rocol Kilopoise 868 (small amount)
Release arm 238: Slide faces against brass arms on chassis Arm 236: Point of rotation on chassis and slide face against chassis 261 Threaded pin on clamp 226: Slide face against connecting piece 211 Bottom bearings for flywheel Arm 256: Slide faces against chassis	3984218 Molykote DX paste (small amount)
* Note!! Two different thrust rollers exist 	A: as above B: 3984013 Turbin oil 30

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ELECTRICAL ADJUSTMENTS

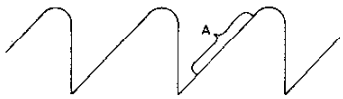
Capstan motor speed

Put wow tape (6780037) in cassette holder. Connect wowmeter to tape recorder output.
Check adjustment on driftmeter of wowmeter.
Set tape recorder to "Playback". With 4R10 (C2) adjust for correct speed reading on driftmeter of wowmeter.
Make adjustment in middle of wow tape.
After having made speed adjustment, check take-up moment.

Take-up moment

Connect 33 ohms in parallel with take-up motor (in parallel with 3C10 (A2)).
Disable current limiter by shorting 6R2, 3.3 ohms.
Connect oscilloscope across motor (note chassis potential on oscilloscope).
Emty cassette holder.
Place tape recorder in Play mode.
Set potentiometer 6R8 (B1) in one extreme position (slow-running motor).
With 6R13 (C1) adjust so that take-up reel is revolving slowly (approx. 1 rev/sec).
With 6R8 adjust for correct curve shape on oscilloscope pattern.

Wrong



Right

Wrong

Adjust 6R13 for quick-running motor.
Activate the Stop function, remove 33 ohms and place momentum measuring cassette in cassette holder.
Place tape recorder in Play mode and adjust take-up moment with 6R13. To allow for running-in of new motors, an entirely new motor must be adjusted to a take-up of 100 p cm.
After approx. 100 hours of operation the take-up moment will increase to the correct value of approx 110 p cm.
Remove short from across 6R2.
Take-up adjustments should be made with tape recorder in cold condition.

References are for left channel (bracketed references are for right channel).
While making electrical adjustments and measurements, no exension lead must be installed in the connector at the tape heads.
Electrical adjustments are made without dolby.

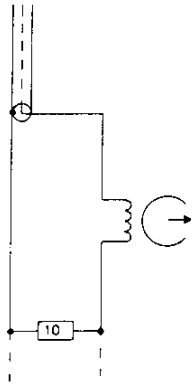
19 kHz filter

Connect tone generator to dolby input IC43 (C3) (1C10(C2)) and set to deliver 19 kHz (∓200 Hz), 100 mV.
Connect millivoltmeter to dolby output 1C56(B4) (1C22 (B3)).
Adjust coil 1L6 (B4) (1L2 C1)) for min. millivoltmeter reading..

Playback level

Demagnetise tape heads and erase head.
Put Pegel Tape (6780035) in cassette holder.
Connect millivoltmeter to dolby output 1C56 (B4) (1C22 (B3)).
With 1R73 (D3) (1R19 (C3)) adjust for 740 mV at dolby output.

Bias filter



Install 10 ohms in series with chassis lead of tape head.
Set tape recorder to "Rec" mode.
Connect oscilloscope across 10 ohms.
Turn bias trimmer 1C70 (A2) (1C72 (A2)) towards min. until the displayed curve is undistorted.
Adjust filter 1L8 (A3) (lL4(A3)) for max. response on oscilloscope.

Peak program meter

Connect tone generator to dolby input lC43 (C3) (1C10(C2)) and set to deliver 300 Hz, 100 mV range. Connect millivoltmeter to dolby otuput 1C56(B4) (1C22(B3)).
Set tone generator so that 720 mV is measured at dolby output.
Adjust 2R51 (A4) (2R28 (B4)) so that 0 dB lamp only just lights.
Back off tone generator 20 dB.
Adjust 2R44 (A4) (2R21 (B4)) so that – 25 dB lamp only just lights.
Readjustment of 2R51 (2R28) may be necessary.

Recording current and bias, CrO_2

If circuit board No. 1 is lifted, it must be connected to chassis through a wire.
Set bias trimmers 1C70 (A2) (1C72 (A2)) to mid-position. (With Rec function activated, measure on tape head with AF vacuum-tube voltmeter and set 1C70 (A2) (1C72 (A2)) for one-half max. voltage).

Set recording-current potentiometers 1R99 (A2) (1R47 (A2)) to mid-position.
Connect tone generator to tape recorder input.
Connect millivoltmeter to Dolby output. 1C56 (B4) (1C22 (B3)).
Put CrO_2 tape of the type for which bias is to be adjusted in cassette holder.
Place tape recorder in Rec mode.
Set tone generator to deliver 333 Hz, 10-30 mV.
Set record potentiometers for 200 mV af Dolby output.
Now, for both record and playback, adjust recording current with potentiometer 1R99 (A2) (1R47 (A2)) so that 200 mV is measured at Dolby output during both record and playback.
Set tone generator to deliver 16 kHz, 10-30 mV. Place tape recorder in Rec mode.
Adjust 1L7 (A3) (1L3 (A4) for max. light VU meter reading.

Set tone generator to deliver 333 Hz 22 mV as measured with millivoltmeter at tape recorder input.
Set record potentiometers to VU 0.
Back off tone generator by 26 dB.
For both record and playback at 333 Hz and 15 kHz adjust 1C70 (A2) (1C72 (A2)) to have same level (2 dB difference in level at 15 kHz represents approx. 1 dB difference in bias.
At –dB in level give less bias).
Check recording current.

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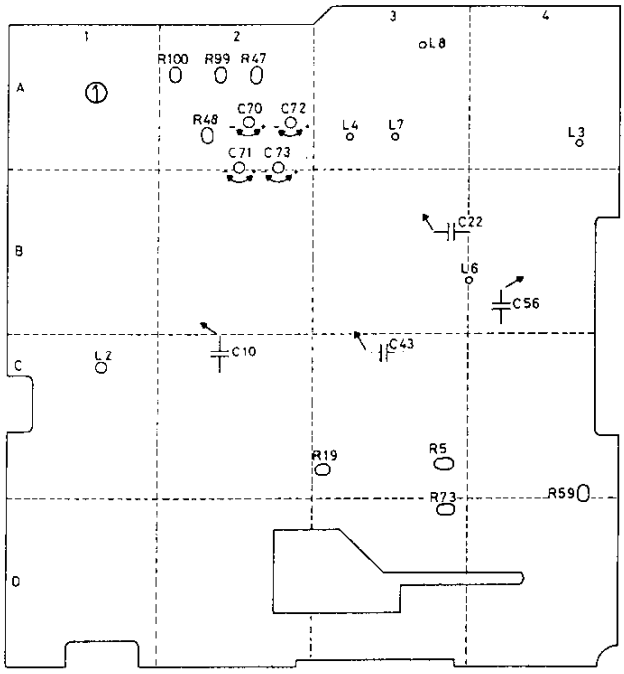
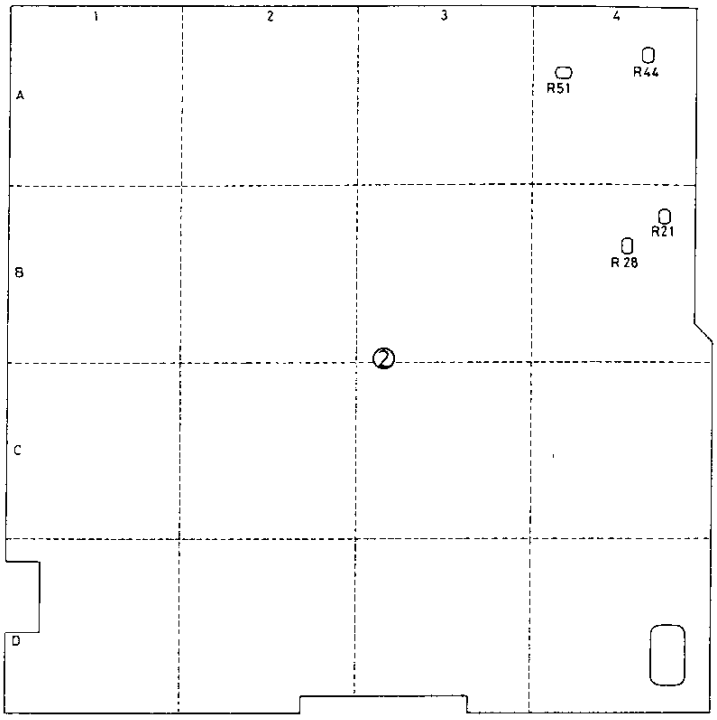
Recording current and bias, Fe_2O_3

Place the tape recorder in the Rec mode.
Set bias trimmers 1C71 (A2) (1C73 (A2)) to 8 V as measured with vacuum-tube voltmeter on tape head.
Set recording-current potentiometers 1R100 (A2) (1R48 (A2)) to mid-position.
Connect tone generator to tape recorder input.
Connect millivoltmeter to Dolby output 1C56 (B4) (1C22 (B3)).
Put Fe_2O_3 standard tape (6780043) in cassette holder.
Place tape recorder in Rec mode.
Set tone generator to deliver 333 Hz, 10-30 mV.
Set record potentiometers for 200 mV at Dolby output.
With potentiometer 1R100 (A2) (1R48 (A2)) adjust recording current so that 200 200 mV is measured at Dolby output during both record and playback.
Set tone generator to deliver 333 Hz 22 mV as measured with millivoltmeter at tape recorder input.
Set record potentiometers to VU O.
Back off tone generator by 26 dB.
Record and play back 333 Hz and 14 kHz.
Adjust 1C71 (A2) (1C73 (A2)) for flat frequency response (2dBdifference in frequency response represents approx. 1 dB difference in bias).
Check recording current.





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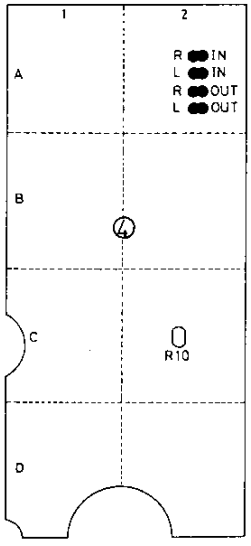
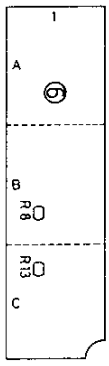
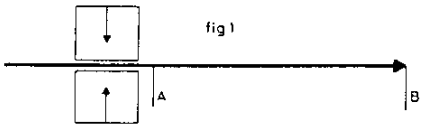




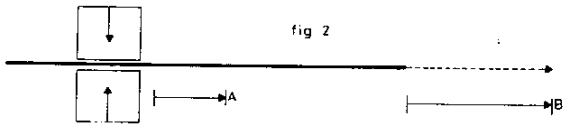
DESCRIPTION
TRANSPORT MECHANISM

Double Capstan System

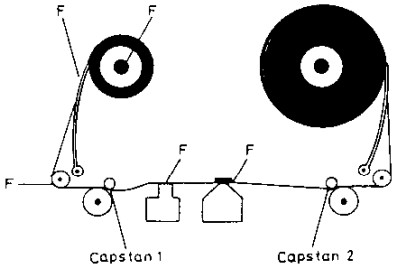
The Beocord 5000 has a double thrust-roller and capstan system which makes for better tape tension and counteracts such friction as would otherwise cause flutter. The phenomenon of flutter can best be explained by comparing the forward tape movement to a flat rubber band which is being pulled through a load (see fig. 1).



Owing to elasticity between A and B, the point B will travel at higher speed than A.

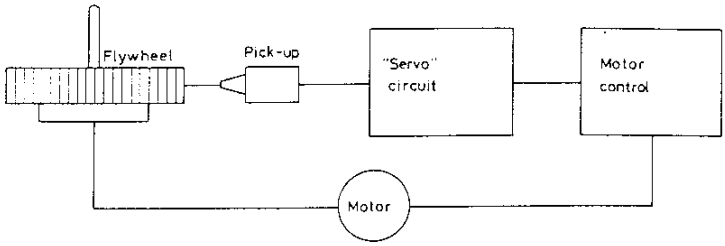


When the point B has travelled from the starting point in fig. 1 to the position shown in fig. 2, less elacticity will be present between A and B, and A will "jerk" towards B, and the elasticity between A and B will increase. In other words, the rubber band will constantly travel through the load in "jerks". The magnitude of these "jerks" will depend on the distance between A and B; the shorter distance, the less elasticity and the smaller "jerks". These small "jerks" appear as flutter in a tape recorder.



By means of an additional capstan shaft (1), the distance between points of friction (F) and points of pull is reduced. This decreases the "spring action" mentioned thus drastically reducing flutter.

The capstan motor is a tacho-controlled asynchronous unit. The motor forms part of a combined electronic and mechanical circuit in which the motor is controlled by the flywheel speed.



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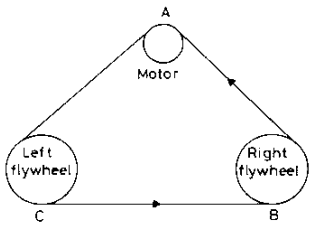
A decrease in flywheel speed will immediately cause a signal to be given through the "servo" circuit, and the motor speed will increase until correct flywheel speed has been regained. This "servo" control will likewise speed the motor heavily up at the start, so that the flywheels will quickly reach their correct speed even if their mass is much larger than that of the motor. Because their mass is large compared to that of the motor, the flywheels respond sluggishly to rapid stresses transmitted to them via the driving belt, for instance when a defect on the belt passes by the driving bush. The motor is highly sensitive to these defects, due to its low mass, but this is immaterial because the motor is controlled from the flywheel.

This difference in mass in conjunction with "servo" control consequently causes a heavy reduction of belt-generated wow. In addition, better long-term stability is obtained; rubber belts will always stretch and become less elastic after operation over some length of time, resulting in speed variations. In the Beocord 5000, belt stretching is of no consequence since the only thing that can change the speed is a change in the tolerance on the time constant of 4C4 and 4R7 in the "servo" control circuit.

Forward Tape Transport

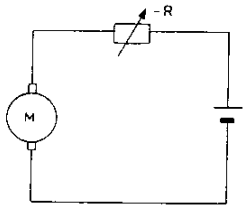
An additional advantage of the double capstan arrangement is more constant tape tension. If the flywheels run freely – that is, without thrust roller pressure – friction in the capstan bearings will be very low. However, driving-belt elasticity will cause the speed at point A to be higher than that at point B, which in its turn is higher than at point C (see Sketch 3).

fig 3



but since the belt-pulley circumference of the left flywheel is smaller than that of the right one, the left flywheel will run a little faster than the right one. As soon as the thrust rollers impose a load on the capstan shafts, friction between capstan shafts and capstan bearings will increase "spring action" by the driving belt; the right flywheel will run faster than the left one, increasing the tape tension.

To ensure that the forward tape transport will be as constant as possible throughout the operation, the take-up motor is a DC unit with active motor control. A negative resistance in series with the motor enables the take-up pull to be kept constant even under conditions of varying motor load.

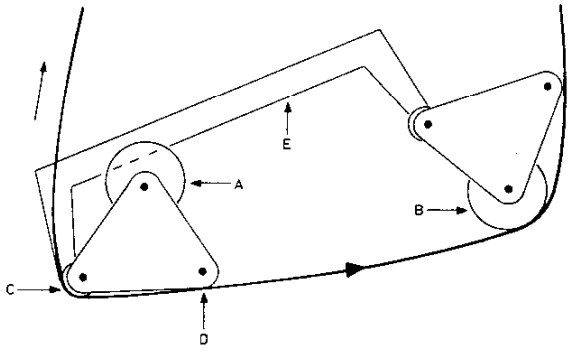


Free Wheeling

A free wheel system allows changing from e. g. fast forward to fast rewind by merely reversing the voltage across the motor.

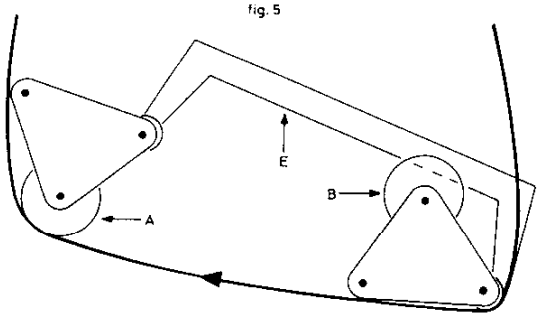
Sketch 4 shows the free wheel system in the normal forward position.

fig. 4



A pin in belt pulleys A and B cause the left and right turntables, respectively, to rotate by means of corresponding pins in the latter. If the voltage across the motor is reversed, the belt will run in the opposite direction, and friction will occur at points C and D. This friction will pull the left free wheel mechanism in the direction of the arrow; the arm E will push the right free wheel mechanism in the same direction. When the left free wheel mechanism has run so far in the direction of the arrow (fig. 4) that the friction at D ceases, the belt will begin to drive pulley A, and the rewind operation begins (see fig. 5).

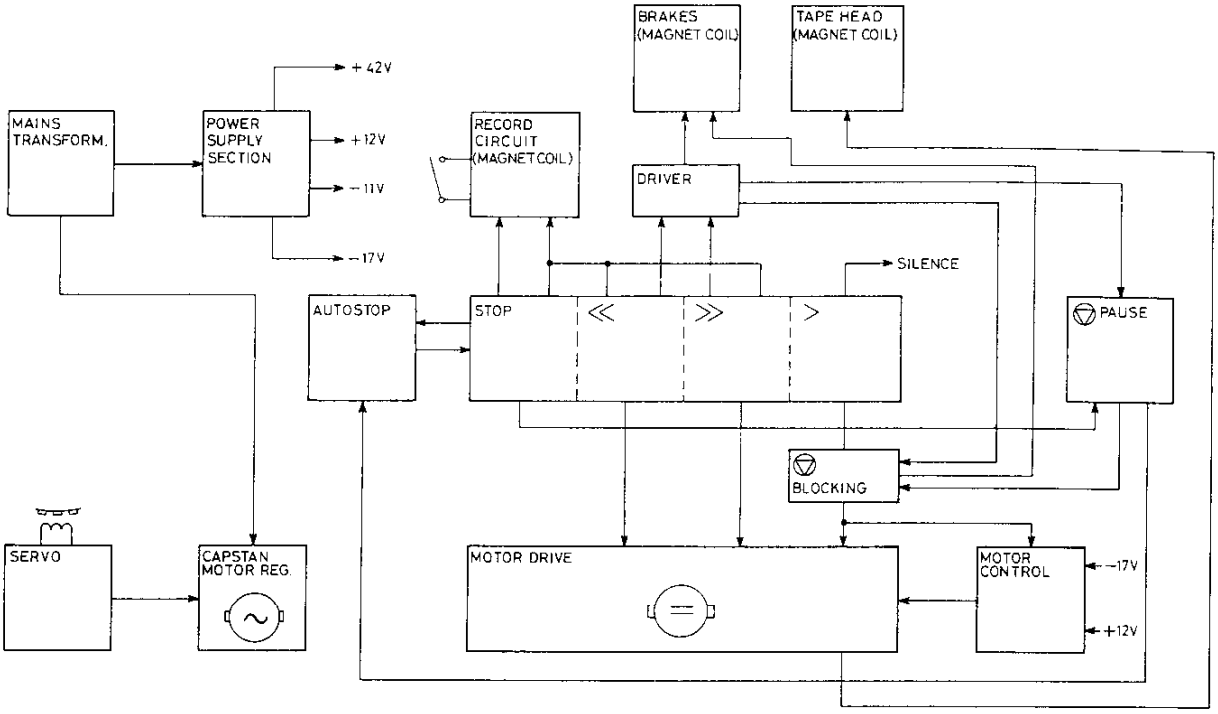
fig. 5



Bang&Olufsen

ELECTRICAL
DESCRIPTION
Control Electronics

The electronics controlling the mechanical functions of the tape mechanism are illustrated, in broad outline, by this block diagram.



The central feature of this control system is an electronic switch which can be activated from the tape mechanism's control panel.

Let us go through the individual blocks.

The "Stop" section of the electronic switch, in addition to overriding the three other switch sections, releases the pause and record functions when "Stop" is activated. Furthermore, a level is transmitted from the "Stop" section to the "Rec" circuit, ensuring that "Rec" can be activated only with the Beocord 5000 set at stop. The "Stop" section can be activated by the "Autostop" circuit. The fast forward and rewind sections perform the same functions except that the "Motor Drive" circuit is activated in opposite directions depending on which section is activated. The identical functions are: Release of the other functions, such as Rec, STOP, normal forward run and pause; and activation of the brake magnet coil via a driver, thereby disengaging the turntable brakes.

The information supplied by the "Normal Forward" section passes via a pause blocking circuit to "Motor Drive", thereby determining the motor's direction of rotation; this information is also fed to the "Motor Control" circuit which regulates the current-to-voltage ratio for the "Motor Drive" circuit and hence the momentum of the take-up motor. In this function, a signal is fed from "Motor Drive" to the tape head bridge's magnet coil which pulls the tape heads and thrust rollers into engagement. Information for the silence circuit in the AF signal output circuit is taken off from the "Normal Forward" section.

"Pause" can, with the recorder in the "Normal Forward" mode, via the pause blocking circuit stop the information for the "Motor Drive" and "Motor Control" circuits without causing the electronic switch to change levels. "Pause" moreover furnishes information to the "Autostop" circuit so that the latter circuit will not activate "Stop" when the tape stops due to "Pause" being activated.

"Autostop" as stated above can be blocked from the "Pause" circuit. The information to the effect that the tape has run against the stop is received by the circuit from a hall cell and fed on to the "Stop" section of the electronic switch, thereby activating it.

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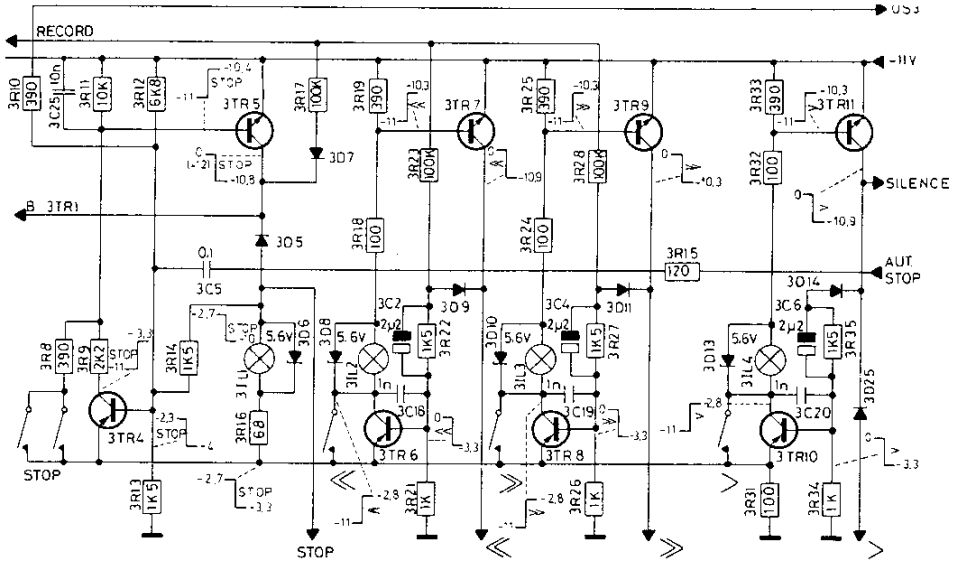
The "Rec" function has two blocking mechanisms. One is the contact which senses if the recording protection pawl at the back of the cassette is removed; the other is information from the "Stop" section of the electronic switch to ensure that "Rec" can be activated only with the Beocord 5000 set at stop. Locking of the "Rec" function occurs only when "Normal Forward" is activated as in that case the information at the outputs of the "Stop" and fast forward and rewind outputs will disappear, and it is the same information which is capable of again releasing "Rec".

The capstan motor is an asynchronous motor. The motor is controlled by a servo system which senses the speed of the flywheel.

The Beocord 5000 has a power supply which delivers both a positive and a negative voltage.

Electronic Switch

The electronic switch, which has four sections, employs two transistors in each section, and the sections release each other by means of a common emitter resistor.



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Let us use as our starting point the situation that "Normal Forward" is activated. In this situation 3TR10 and 3TR11 are drawing current. 3IL4 indicates the function. The collector of 3TR11 has a level of approx. −11 V. The three other sections draw no current, and their outputs will be neutral, which means that the collectors of 3TR5, 3TR7 and 3TR9 carry a potential of 0 volts, except for the collector of 3TR5 when the record blocking switch is closed (record facility), when +12 V will be present at it. If now, say the fast forward function is activated, current will be drawn through the bias voltage divider of 3TR9, whose base will therefore receive an amount of bias that will make it draw current through the bias voltage divider for 3TR8 and hence also through 3TR8, causing the function to be held with −11 V at the collector of 3TR9. The operation of the fast forward switch causes approx. twice as high current to flow through the common emitter resistor 3R31, with consequent higher voltage. This causes the base-emitter junction of 3TR10 to be reverse biased, thereby releasing the normal forward function.

Fast rewind and stop can be activated in a similar manner.

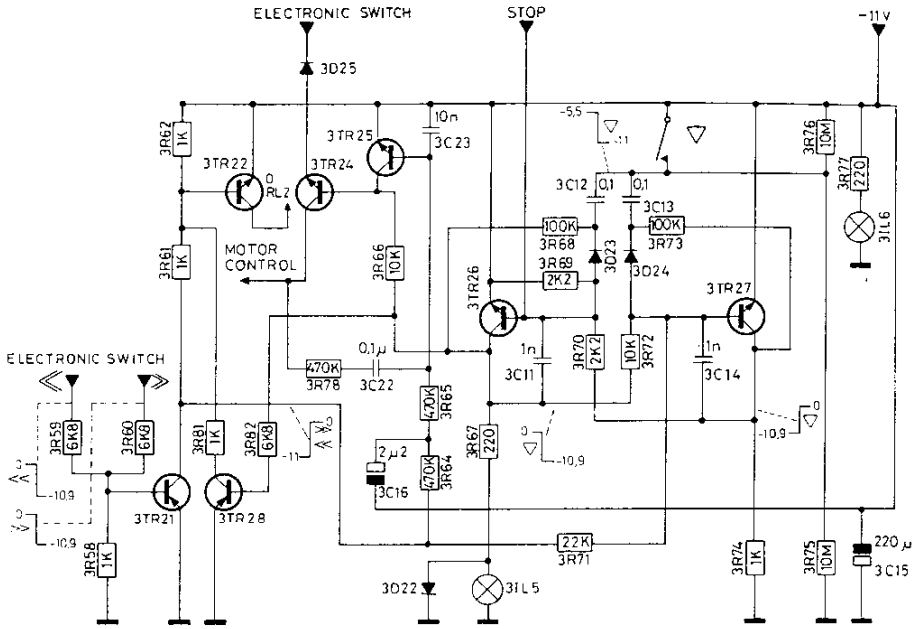
In the "Stop" section, however, there is a difference: The indicator lamp is in the collector circuit of the hold transistor 3TR5, and the bias voltage divider for 3TR4 has a different ratio and a resistor directly to −11 V, ensuring that the switch will always start in the stop position.

The Zener diodes across the filament lamps perform a dual function by ensuring both that the voltage across the lamps does not exceed 5.6 V and that the switch can function even if the lamps open.

Diodes 3D5, 3D7, 3D9, 3D11 and 3D14 are stop diodes which ensure that voltages entering the outputs cannot trip the electronic switch.

In the following, high should be regarded as a negative level relative to chassis potential (low).

Pause Function



The pause function is controlled from a flip-flip of which 3TR26 and 3TR27 are parts. The flip-flop trips every time the pause button is depressed.

When the stop button is depressed, a negative pulse is applied to the base of 3TR26; the transistor cuts off and its collector goes towards zero; 3TR27 is forward biased and its collector goes high. In this condition the collector of 3TR26 and hence also the base of 3TR24 will be low.

If the normal forward function is activated, 3TR24 is forward biased; the transistor draws current and supply voltage is fed to the motor regulation circuit.

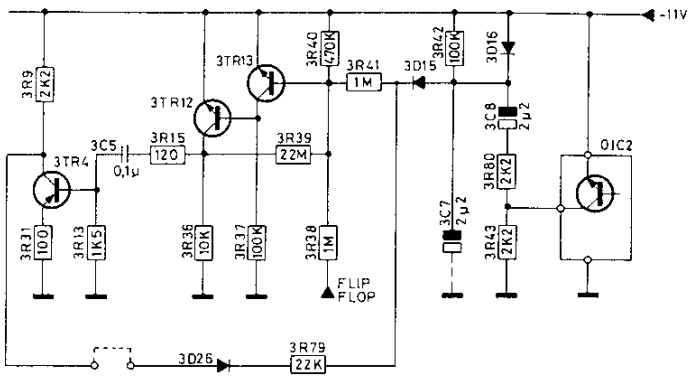
If the pause button is operated, a negative pulse appears at the bases of 3TR26 and 3TR27. 3TR27, which draws current, will now cut off; the collector goes low; 3TR26 is forward biased; its collector goes high; 3TR24 is reverse biased and the supply voltage is removed from the motor regulation circuit.

At the same time 3TR28 is forward biased, collector goes low, and 3TR22 is forward biased so that the brake magnet coil 0RL2 is activated.

For fast tape run, a low level is applied to the bases of 3TR27, thereby locking the flip-flop.

When switching from fast tape run to normal forward run, it is necessary to ensure that voltage will not be applied to the take-up motor's regulation circuit faster than the mechanical functions can reset themselves. This is done by means of 3TR25. For fast tape run, the collector of 3TR21 is low; 3TR25 will be forward biased through 3R65 and 3R64, and 3C16 will carry a charge. If the normal forward function is activated, the collector of 3TR21 goes high, but the discharge of 3C16 will attempt to keep up a flow of current in 3TR25, and the collector of 3TR25 will slowly go low. To limit the slowness of the coupling to 3TR25, 470 k and 0,1 μ are inserted as a speed-up network. When the collector of 3TR24 goes towards negative, this level is transmitted via the speed-up network to the base of 3TR25, causing it to cut off. Hence the slowness of 3TR25 will be effective only until 3TR24 begins to draw current.

Automatic Stop



The automatic stop function is controlled by a Hall cell.
The Hall cell is activated by an 8-pole magnet.
The Hall cell is opened or shorted from −11 V and the junction of 3R43 and 3R80, depending on the strength of the magnetic field passing through the cell.
If the magnetic field is strong, the cell is shorted (ON); if the field is weak, the element is open (OFF):
When 0IC2 is ON, 3C7 will charge towards −11 V through 3TR13, 3R40 and 3R41.
0IC2 goes OFF, 3D15 is forward-biased, and 3C8 will draw charging current from 3C7 through 3D15.
0IC2 goes ON, causing 3C8 to discharge through 3D16 and 3R80. 3C7 again obtains a full charge.
This charging and discharge current will keep 3TR13 forward biased; 3TR13 draws current, keeping 3TR12 cut off.
When the end of the tape is reached, the counter magnet stops; 3C7 can now again obtain a full charge.
3TR13 is reverse-biased, and 3TR12 is forward-biased through 3R37.
3TR12 draws current; its collector goes towards −11 V. This voltage change from 0 V to −11 V is applied to the electronic switch via 3C5 and 3TR15, activating the stop function.
To prevent the Play function from being activated after stop at end of tape a network has been introduced, consisting of 3D26 and 3R79.
With the Stop function activated, −3.3 V will be present at the collector of 3TR4, and the voltage at 3C7 will be clamped to −3.3 V through 3D26 and 3R79.
3TR13 will now be forward-biased again, and 3TR12 ceases to draw current.
The collector voltage of 3TR12 goes towards 0 V, 3C5 discharges, and when Play or Fast Forward or Reverse is activated, the voltage at the collector of 3TR4 changes to −11 V. The charge on 3C7 goes towards −11 V, and the circuit will now activate the Stop function as previously described.
To prevent the Stop function from operating when the tape recorder is in the Service mode, the circuit board incorporates a shorting strap (A) which must be lifted when the counter belt is taken off.

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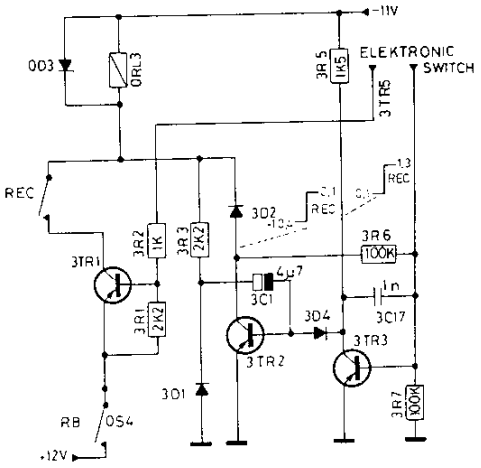
Record Function



The record function is controlled from the electronic switch so that recording is possible only with the Beocord 5000 set at "Stop" and the "Rec" button depressed, whereupon the normal forward button must be depressed. The switch on the back of the cassette holder (to the left) ensures that tapes cannot be erased if the plug at the back of the cassette is removed.

When 0S4 makes contact (cassette in place) and the "Stop" function is activated, 3TR1 will conduct because it has a high level from the electronic switch applied to its base via 3R2 and 3R1. The magnet coil 0RL3 will then operate when the "Rec" switch is activated. Simultaneously therewith, 3C1 picks up a positive charge through 3R3. If the normal forward function is activated, the base of 3TR3 goes low; the collector goes high; 3TR2 is forward biased; and current flows through 0RL3, 3D2 and 3TR2; and the magnet coil will remain operated.

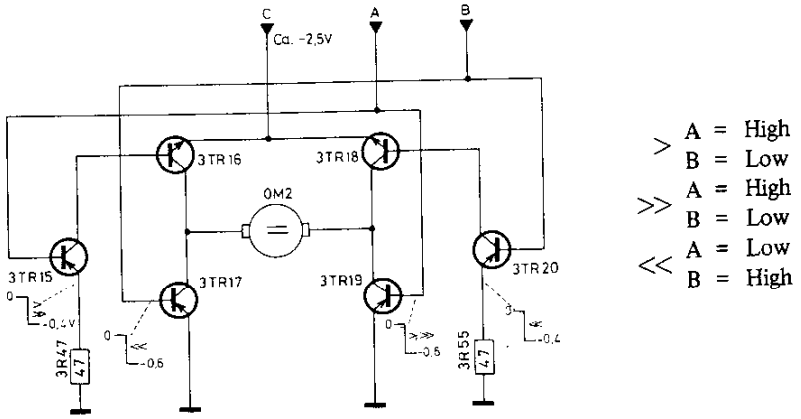
Simultaneously with normal forward run being activated, the high level at the base of 3TR1 disappears. 3TR1 cuts off, and 3C1 will discharge through 0RL3 and consequently ensure that 0RL3 stays operated while the locking circuit 3TR2 and 3TR3 switches over. 3R6 provides positive feedback to make the circuit switch faster.

Diode 3D4 blocks the passage of the discharge current of 3C1, ensuring that the discharge current is drawn through the base-emitter junction of 3TR2 and thereby aiding to forward-bias 3TR2.

3D1 prevents voltage of the wrong polarity from reaching 3C1.

0D3 protects 3TR1 against induction peaks.

Take-up Motor Control



Normal Forward

The direction of current flow in the motor control circuit is controlled from the electronic switch.
For normal forward run, the bases of 3TR15 and 3TR19 are made high, and they are forward biased. The collectors of 3TR15 and 3TR19 go low; 3TR16

is forward biased, and one side of the motor is shorted to chassis potential through 3TR19. The bases of 3TR17 and 3TR20 are made low; the collectors go high; 3TR18 is reverse biased; and the motor starts normal forward run. The motor draws current from the motor regulation circuit through 3TR16 and 3TR19.

Fast Forward

For fast forward, the motor regulation circuit is inoperative, and the supply voltage at point c will be approx. –12 V. Since the inputs from the electronic switch (A and B) are at the same levels as during normal forward run, the direction of current flow in the control circuit will also be the same as during normal forward run, the only difference being that the voltage across the motor increases from approx. 2.5 V to approx. 12 V.

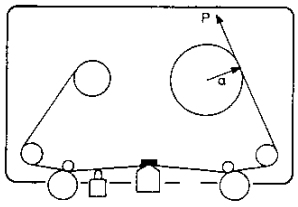
Fast Rewind

For fast rewind, the bases of 3TR15 and 3TR19 are made low, and the transistors are reverse biased; the collectors go high.

The bases of 3TR17 and 3TR20 are made high; they are forward biased and the collectors go low. 3TR18 is forward biased, and at the same time one end of the motor is connected to chassis potential through 3TR17, and fast rewind begins. The motor consequently draws current through 3TR18 and 3TR17, and 12 V will be present across it.

3TR15 and 3TR20 likewise function as constant-current generators so that the base currents of 3TR16 and 3TR18 are independent of the voltage across the motor.

Active Regulation of Take-up Motor



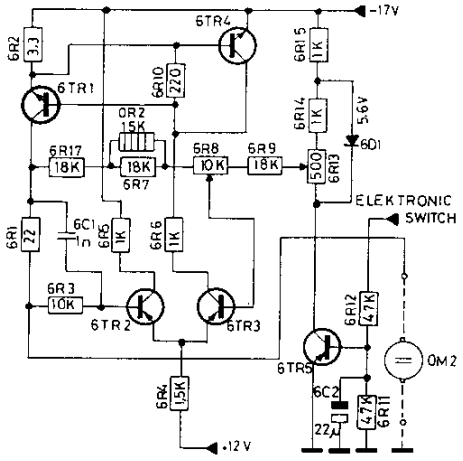
P = take-up tension

a = arm

M = moment

To minimise the wow level it is necessary to keep the take-up constant at all points of the tape.

The motor current and the moment are directly proportional. When the motor speed drops as a consequence of more tape on the take-up reel, the motor current increases and so does consequently the moment, *but not sufficiently so,* and since M = a·P it will be seen that M must be raised when a increases, on order to hold P constant. This is done by raising, in an active circuit, the voltage across the motor when the current in the motor increases.



During normal forward tape run, the base of 6TR5 is made high (–11 V). The transistor is forward biased and begins to draw current. 6D1 keeps the control range of 6R13 constant. The voltage at the arm of 6R13 is applied to the base of 6TR3, which together with 6TR2 operates in a differential circuit, in which 6R4 is the common emitter resistor. If, therefore, 6TR2 draws more or less

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current, 6TR3 will draw more or less current, respectively. The collector voltage of 6TR3 controls the base of 6TR1, which functions as a variable resistor in series with the motor.

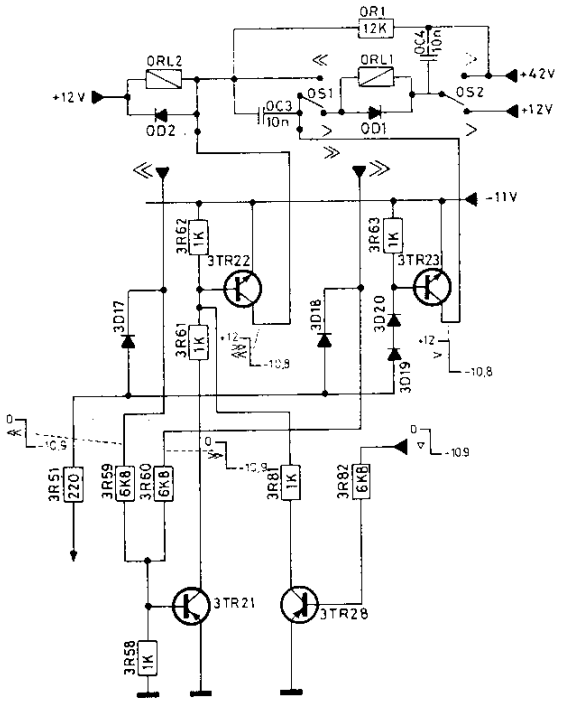
When the current in the motor increases in consequence of more tape on the take-up reel, the base bias of 6TR2 becomes less negative; 6TR2 draws less current, and 6TR3 draws more current; the collector becomes less negative; 6TR1 draws more current; the collector becomes more negative, and the voltage across the motor increases. The voltage across 6R1 likewise increases; part of this voltage change is fed via voltage divider 6R17 – 6R7 – 6R8 – 6R9 to the base of 6TR3, resulting in heavier regulation of the current in 6TR1. 6R8 controls the base bias of 6TR3, determining how much of the voltage change across 6R1 is to be fed back to the base of 6TR3.

6TR4 functions as a current limiter. When the current in 6TR1 increases so much that the voltage across 6R2 reaches approx. 0.65 V, 6TR4 will begin to draw current so that all further current increase in 6R6 will be fed around the base of 6TR1, and the current through that transistor will be limited to approx. 200 mA.

For fast forward and rewind, the base of 6TR5 is low and the collector high. 6TR3 and hence also 6TR1 are forward biased, resulting in approx. – 12 V across the motor.

6R16 and 6R17 function as a temperature stabiliser.

Magnet Coil Circuit



The magnet coil circuit is controlled from the electronic switch. For normal forward run, the anode of 3D19 is shorted to chassis potential through the motor control circuit (3TR19); 3TR23 is forward biased; the transistor draws current; and coil 0RL1 operates.

For fast forward and rewind, the base of 3TR21 is made high; the collector goes low; and 3TR22 is forward biased. 3TR22 draws current and 0RL2 operates. From 3D17 – 3D18, respectively, –11 V is applied to the anode of 3D19; 3TR23 cuts off and 0RL1 released.

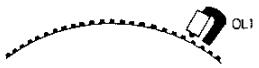
0D1 and 0D2 protect 3TR22 and 3TR23 against induction peaks. S1 produces a small time delay from << to > so that the motor will have time to reset itself before the tape head bridge pulls completely to.

S2 switches the voltage across the magnet coil so that +42 V is present across it the moment the coil operates, but when the tape head bridge has been pulled to, S2 switches over, and 12 V is present across 0RL1.

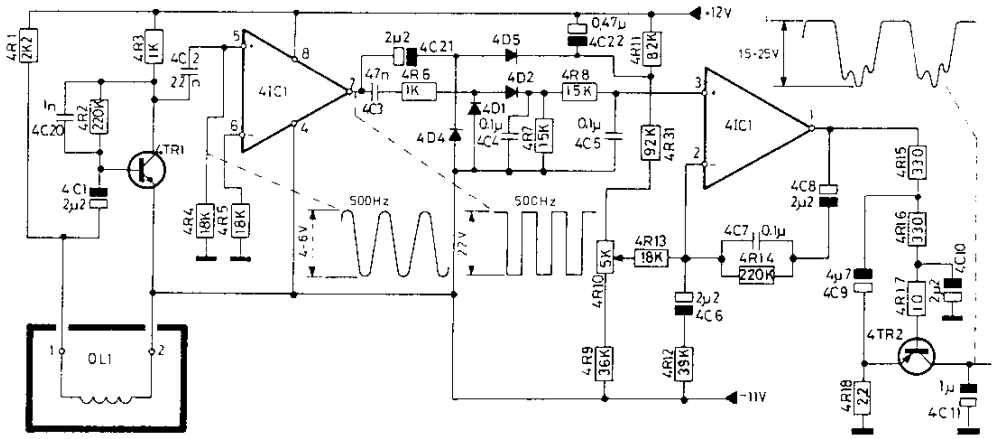
When −11 V is removed from 0RL2, a low positive current is passed from 0RL2 from +42 V through 12 k ohms to ensure instant coil release.

Capstan Motor Regulation

The capstan motor regulation circuit is controlled directly by the flywheel speed. The rim of the flywheel is toothed.



0L1 is located close (0.5 mm) to the rim of the flywheel so that the coil inductance will be dependent on the spacing between the coil core and the flywheel; the spacing will of course change constantly depending on whether the coil is passed by a "tooth" or by a space between two "teeth". By feeding a DC current through the coil and simultaneously changing its inductance we shall obtain a sine curve across 4R1. Lower flywheel speed will therefore be attended by lower sine frequency.



This sine curve is amplified by 4TR1 and applied to pin 5 of 4IC1, which is an operational amplifier.

4IC1 is driven so hard that the sine-wave signal applied will be heavily clipped. This clipped sine-wave is taken off through 4C3; the signal is clamped to −11 V through 4D1 and rectified through 4D2, and the resulting DC level at 4C4 is therefore dependent on the sine-curve frequency and on 4C3, 4R7 and the voltage swing at pin 7.

Since the output impedance at pin 7 of 4IC1 may vary considerably, 4R6 in series with the signal will eliminate unstability.

The signal at 4C4 is applied to pin 3 of 4IC1 and amplified. Frequency-dependent inverse feedback voltage is taken off from pin 1. 4R10 enables adjustment of the motor speed. The voltage at the arm of 4R10 is fed, together with the inverse feedback voltage, to pin 2 of 4IC1. The level at pin 2 is reference voltage for the rectified voltage so that it is the difference from pin 3 to pin 2 which is being amplified.

Temperature variations may cause the amplitude of the square-wave signal (pin 7) to vary; this will be seen as a DC change at pin 3. To counteract this change, the reference point at pin 2 must be changed commensurately. The square-wave signal is transmitted through 4C20; the signal is clamped to −11 V through 4D4 and rectified by 4D5, resulting in a DC voltage at the reference point, pin 2, which will change just as much as the voltage at pin 3 if the latter voltage change is caused by an amplitude change.

The DC level at pin 1 is fed via a low-pass filter to the base of 4TR2 so that a lower sine frequency at 0L1 will cause the base of 4TR2 to become more negative.

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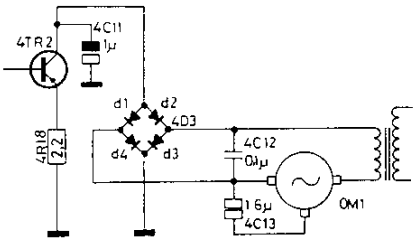
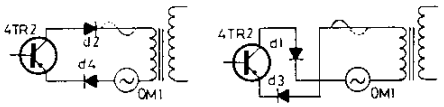
Motor Control



The capstan motor is an asynchronous motor whose speed is regulated by 4TR2 and D3. 4TR2 may be regarded as a variable resistor in series with the motor.

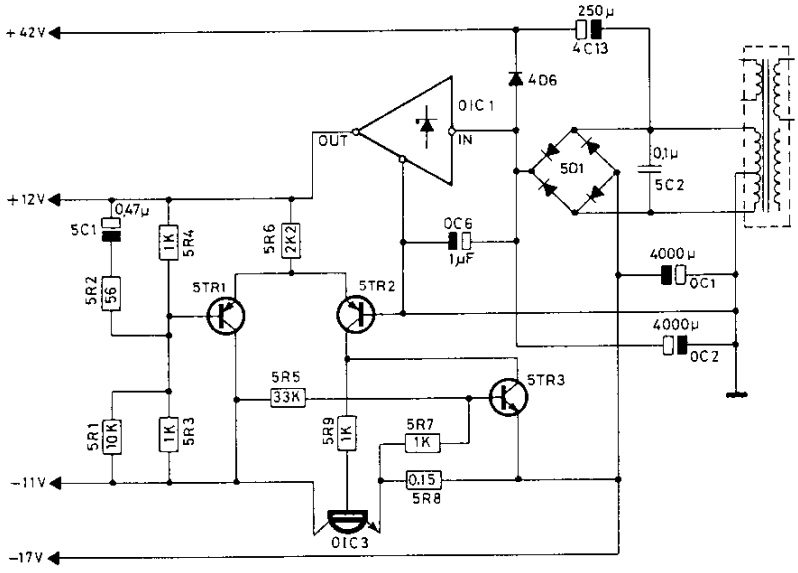
During normal operation on 50 Hz, the collector of 4TR2 is at approx. – 6.5 V (60 Hz approx. – 9.5 V). If the motor speed is too low, the base of 4TR2 becomes more negative; 4TR2 draws more current; the collector goes towards positive (chassis potential); and the motor runs faster.



If the motor is running too fast, the base of 4TR2 becomes less negative; 4TR2 draws less current; the collector goes towards negative; and the motor runs more slowly.

This current-regulating system enables the motor speed to be kept constant.

Power supply



0IC1 is a stabilised power supply which, with a positive input from 15 V to 35 V and with reference to chassis, furnishes stable 12 V output.

The stabilised 12 V potential controls the differential circuit composed of 5TR1 and 5TR2. 5TR2 is forward biased through 5R6; 5TR2 draws current; 0IC1 is forward biased; and –11 V is obtained at the collector.

5TR1 is the –11 V stabiliser. If the –11 V supply becomes more negative, the base and hence also the emitter of 5TR1 become more negative; 5TR2 will draw less current; 0IC1 draws less current, thereby regulating the –11 V supply to correct voltage.

5TR3 functions as current limiter for the −11 V supply. If the −11 V supply is excessively loaded, the current through 0IC3 and hence also through 5R8 will increase, thereby causing the voltage across it to increase. When the voltage across 5R8 reaches a certain level, 5TR3 is forward biased; 5TR3 draws current; the base-emitter junction of 0IC3 is "shorted"; and 0IC3 cuts off.

8D1 and 8C1 are a voltage doubler which boosts the voltage across the magnet coil 0RL1 to +42 V while the magnet coil operates.

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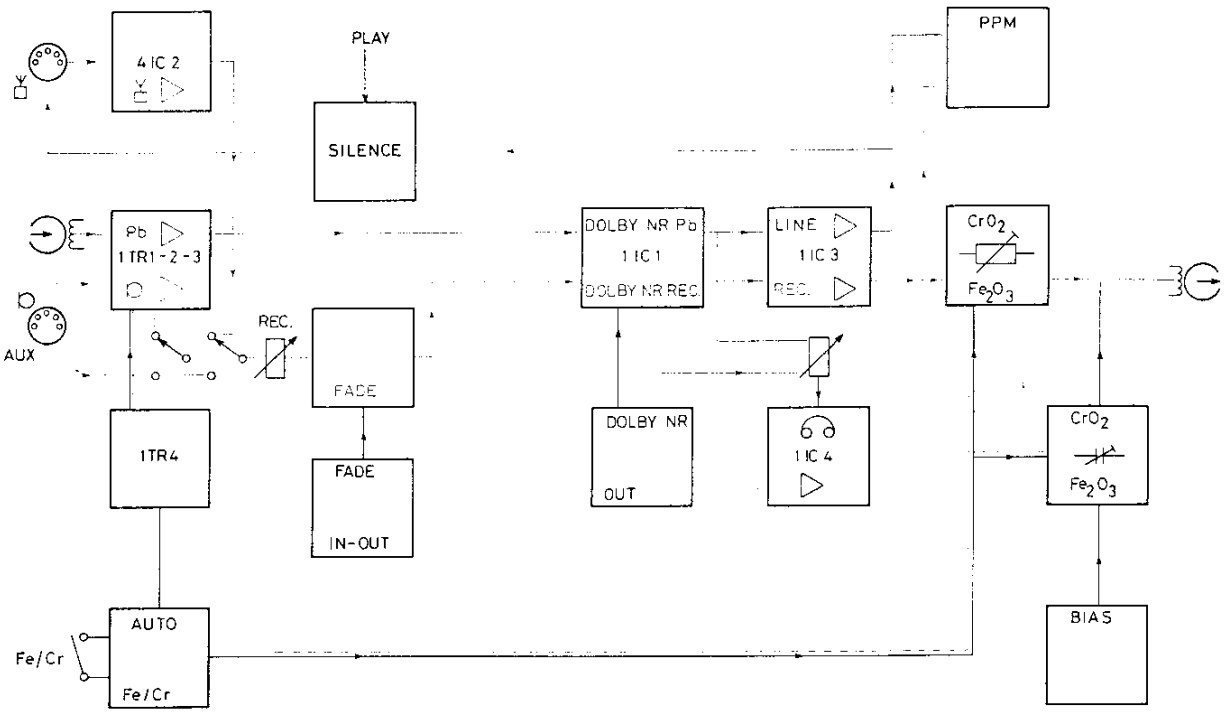
LF DESCRIPTION

Block diagram 2

In principle, the AF signal circuit is built as shown by the block diagram below.

Red lines give the record signal path; green ones denote playback.

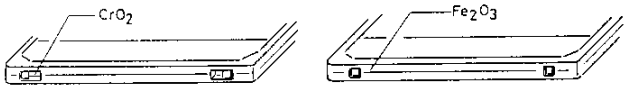
Component designations in the diagram apply to right channel.



As will appear from the block diagram, some of the circuits are used for different purposes during recording and playback. This requires switching, which is performed by the record switch.

It will also appear from the block diagram that the signal path is basically analogous to those of earlier tape recorders for which reason, only the differences will be discussed in detail.

Switching of playback amplifier equalising for CrO_2 and Fe_2O_3 tapes is performed automatically by means of an electronic switch (1TR4) controlled from a sensor in the rear edge of the cassette holder.



The same sensor controls, via a relay, switching between the two different levels of bias and AF recording current.

A novel feature is a fade circuit, which is part of the recording level control. This circuit makes it possible to return to exactly the same recording level after a gain decrease since operation of the fade-out and fade-in controls eliminates the need for operating the record sliders.

The silence circuit is an electronic switch, which is controlled from the electronic switch of the tape mechanism, so that passage of signals is possible only with the "Play" control operated.

Dolby NR/OUT is controlled by a DC level which is generated by a flip-flop. The flip-flop is controlled at the moment of starting so that the recorder is always turned on with the Dolby circuit operative.

PPM, peak program meter, is a feature that so far has been known only in connection with professional tape recorders and consequently is a novelty in cassette recorders. The light-peak program meter is free from inertia, and therefore makes it easier to apply full drive to the tape without overdriving it on quick loud passages.

Microphone/playback amplifier

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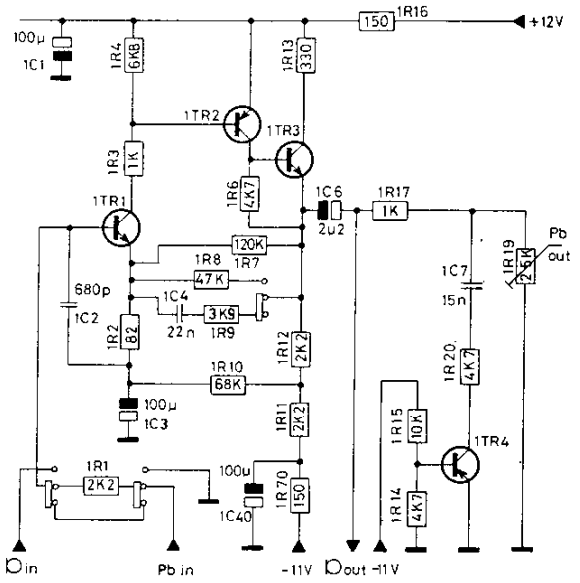


The microphone and playback amplifier has three stages. With the record switch in the record position the amplifier operates as microphone amplifier and in the neutral position of the switch as playback amplifier.

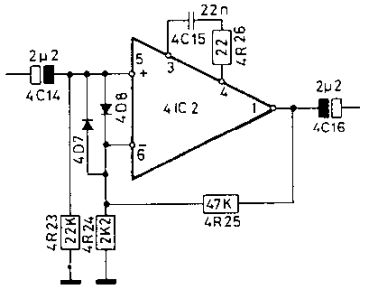
Gain in the microphone position is approx. 50 dB, with a linear characteristic.

In the playback position the equalising circuit is cut in. It follows the time constants of 70 µsec and 3180 µsec for CrO_2 and 120 µsec and 3180 µsec for Fe_2O_3. Switching between CrO_2 and Fe_2O_3 is performed by switch transistor 1TR4.

The first transistor, 1TR1, is controlled DC-wise through the sound head, resulting in optimum noise suppression. Current through the head is of the order of 1 µA, which is considerably below the value, 40 – 50 µA, at which reproduction begins to suffer as a result of DC magnetisation of the head.
With 1R19 adjust the replay level.

Transistor 1TR4 is controlled from a sensor circuit so that 1C7 and 1R20 are connected to earth potential when CrO_2 tape is in the machine.

Radio amplifier

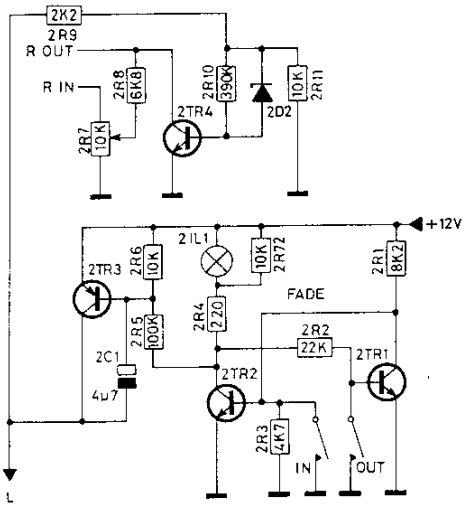


The radio amplifier is designed around an operational amplifier so as to have an input impedance of 22 kohms and a gain of 20 dB.

RC network 4R26 and 4C15 is a stabilising network.

4D7 and 4D8 protect 4IC2 against too high an input voltage, for instance static electricity at connection to an amplifier.

Fade



The fade circuit, which is cut in in connection with the recording level potentiometer 2R7, permits electronic regulation, up and down, between the level preset with 2R7 and zero.

The circuit consists of a bistable multivibrator, a time-constant regulated driver and a regulator transistor. The multivibrator has inherent unbalance so that it will always start in the "Fade in" position; 2TR1 at the moment of starting receives drive through 2IL1/2R72, 2R4 and 2R2 so that the collector voltage and hence also the base voltage of 2TR2 will be approx. 0 volts. 2TR2 draws no current, and its collector voltage will therefore be 11.7 volts.

If the "Out" switch is operated, bias disappears from 2TR1, which consequently ceases to draw current, and the flip-flop trips. 2TR2 draws current through 2R4 and 2IL1 to indicate "Fade out". In this position, the collector voltage of 2TR2 will be approx. 0 volts. 2R72 secures that the function can be activated even if 2IL1 is defective.

The output level consequently is operative:

"Fade in" = 11.7 volts

"Fade out" = 0 volts

These two levels are employed to control the circuit associated with the driver 2TR3. When the circuit has come to rest following a fade-in regulation, the voltage at the base of 2TR3 will be very close to 12 volts; hence 2TR3 will draw no current. 2C1 will hold a charge determined by the base level of 2TR3.

If "Fade out" is activated, the "low" level at the collector of 2TR2 will cause current to flow through 2R5; this current will divide between 2R6 and the base/emitter of 2TR3. 2TR3 draws amplified current through the base voltage divider of 2TR4 and its base. This current will have a low value at first because part of the current through 2TR3 is drawn as a discharge current from 2C1.

The "slowly" increasing current and 2D2 in the base circuit of 2TR4 give a steadily increasing current through 2TR4, causing the signal at the collector to be "slowly" shorted to chassis potential.

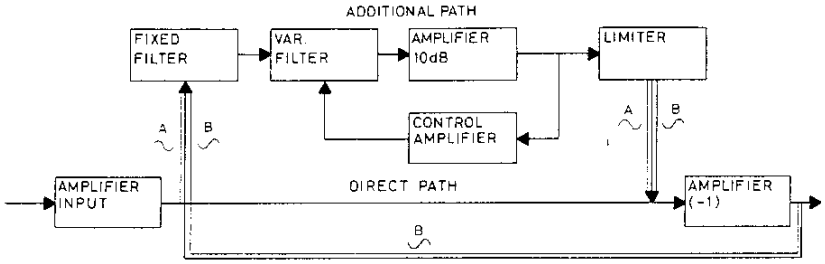
In the fade-out position, the circuit will assume a stable condition in which 2TR3 will draw current and capacitor 2C1 is discharged.

If "Fade in" is activated in this situation, the current through 2R5 ceases because the collector of 2TR2 goes "high". The current through 2TR3 and hence also through 2TR4 is maintained briefly by the control current generated by the current which charges 2C1. The collector current of 2TR3 has the effect of damping the 2C1 charging current, thereby lengthening the charging time.

The current through 2TR3 drops gradually, ceasing entirely when the charging current to 2C1 goes below 60 μA as this is the minimum current which must flow through 2R6 to maintain the bias required for 2TR3. The current through 2TR4 and hence the signal short-circuit will cease in step with the cessation of the flow of current through 2TR3.

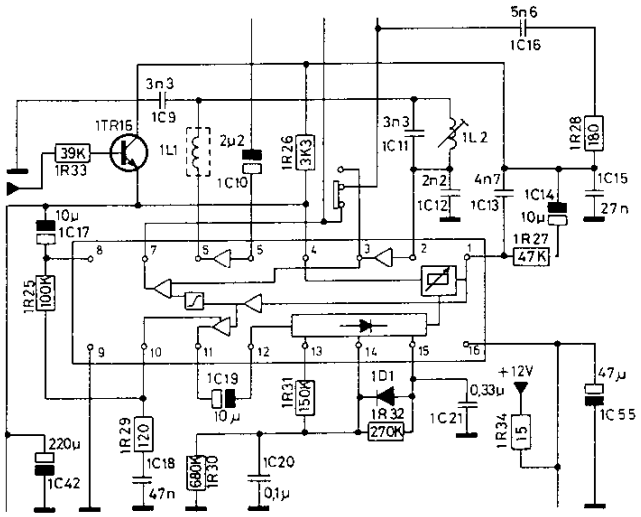
Dolby NR

The Beocord 5000 incorporates an IC for the Dolby B noise-reduction system. The fundamentals of the Dolby system will not be discussed here, except that the system employs two signal paths, a direct path and an additional path, and that the additional path is a means by which signal is added to the direct path during recording and the corresponding signal is subtracted during playback.



Addition and subtraction are produced by taking off signal for the additional path before and after a phase inverter, respectively, as will appear from the sketch above, in which the red line and phase denote recording and the corresponding green one is for playback.

The IC is built into the circuit as shown by the following diagram section.



The input is at pin 5, from which the signal is fed to pin 6 via an impedance matcher. The signal is thereafter taken off from pin 6 and fed via an external 19 kHz filter to pin 2. A 26-dB amplifier goes from there to pin 3. Pin 3 is the place from which signal is taken off for the additional path during recording, which is done by means of the record switch. The direct signal path goes to pin 7 through the amplifier, which has a gain of – 1. Pin 7 is the output of the unit and also the point from where the additional path is supplied during playback.

The additional path goes from the switch, starting with the fixed filter 1C16, 1R28 and 1C15 and continuing via 1C13 which is the capacitor of the variable filter whose variable section is located in the IC, connected to pin 1. The

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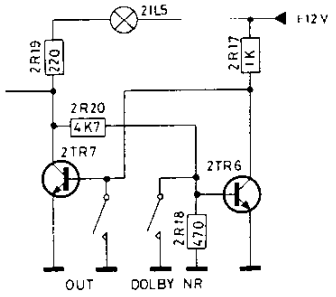
variable function is handled by a FET which receives its reference from pin 4 and is controlled by the rectifier section of the control amplifier.

From the variable filter, the signal is fed to the 10-dB amplifier. Before the signal from the additional path is added to the signal from the direct path in the −1 amplifier it passes through a limiter. The limiter serves the purpose of limiting the additional-path signal during the building-up time of the variable filter. At the output of the 10–dB amplifier a signal is taken off for the control amplifier, from where the signal is fed to the rectifier section through 1C19. The rectifier section controls the cut-off frequency of the variable filter so that the stronger the signal at the output of the 10-dB amplifier, the higher the cut-off frequency.

Components 1D1, 1R32 and 1C21 secure rapid regulation at rapid level shifts whilst providing efficient smoothing of the regulating voltage at constant signals.

The cutting in and out of the Dolby NR unit is done by means of 1TR16. At Dolby NR OUT a positive voltage is supplied to the base of 1TR16, 1TR16 is forward biased and the signal in the additional path is shorted to chassis through 1TR16 and 1C42.

Dolby NR/OUT

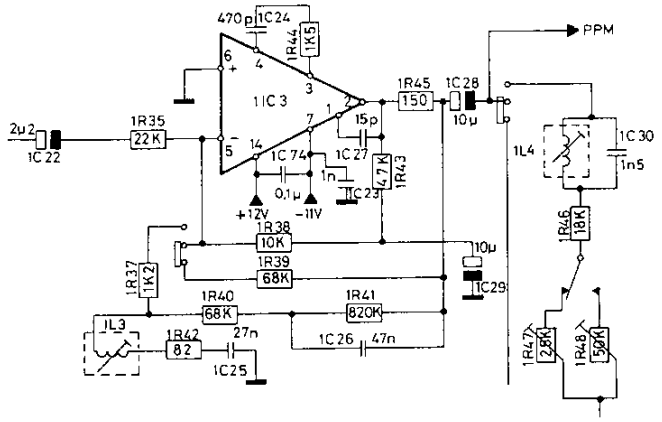


The DC level controlling the Dolby in/out function is generated by the flip-flop shown above.

When the recorder is turned on, the flip-flop is pre-set through 2R17 so that the collector level of 2TR7 is approximately equal to earth potential; this will turn the Dolby circuit on. The "in" condition is indicated by 2IL5.

Operation of the „out" switch trips the flip-flop so that the collector level of 2TR7 will be almost +12 volts, thereby turning the Dolby circuit off.
The Dolby NR switch can return the flip-flop to its starting position.

Recording and line amplifier



The operational amplifier 1IC3 serves as both recording amplifier and line amplifier during playback. Switching between the two functions is performed

via the record switch.

The signal is applied, during both recording and playback, to the Dolby unit via capacitor 1C22.

1IC3 when operated as a line amplifier is switched to provide 10 dB gain with a linear characteristic whereas equalising is introduced during the record function. The equalising function is designed to give flat record/playback frequency response. Coil 1L3 enables adjustment of equalising in the treble range. Potentiometers 1R47 and 1R48 provide a means of adjusting AF recording current for Fe_2O_3 and CrO_2, respectively. 1L4 and 1C30 are a filter to prevent bias from penetrating into the recording amplifier.

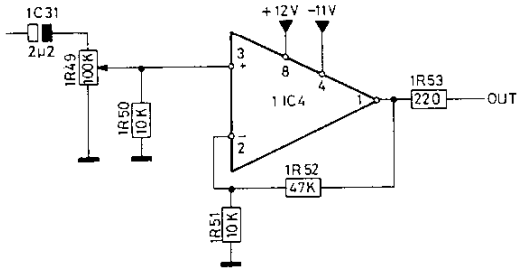
The signal is fed from potentiometers 1R47/1R48 to the recording head in which it is mixed with the bias.

In the playback position, the signal is taken off at 1C28 and fed via a voltage divider to the radio jack.

Resistor 1R44 and capacitor 1C24 as well as capacitors 1C27 and 1C67 all of them serve the interests of stability.

The signal for the peak pulse meter is taken off, during both recording and playback, at the output of this amplifier at capacitor 1C28.

Headphone amplifier



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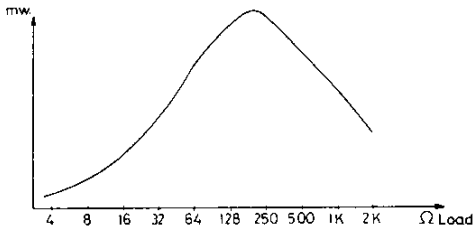
Headphones may be used during both recording and playback. The signal for the amplifier is taken off from pins 3 and 7 of the Dolby unit during recording and playback, respectively, as the signal will then in both cases be identical with the original signal.

The amplifier is an operational amplifier whose gain is determined by the amount of feedback; in this circuit the gain is approx. 14 dB.

The input signal for 1IC4 and hence the headphone-signal level can be adjusted with potentiometer 1R49, physically located at the bottom left edge of the front edge.

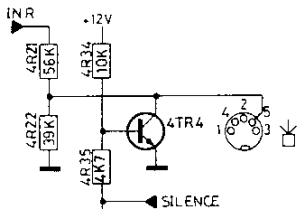


This graph shows headphone amplifier output as a function of load impedance.

Silence

To ensure that signal is applied to the following power amplifier only when the tape recorder "Play" button is operated, a silence circuit has been introduced in connection with the tape recorder's amplifier output.

The circuit is controlled electronically from the electronic switch of the tape drive mechanism so that the signal path is open only when the "Play" button is operated.



4TR4 and its left-channel companion, 4TR3, make up this circuit: when it is desired to block the signal path, they are driven so that the signal is shorted to earth potential.

The electronic switch applies a level of approx. –11 volts to the circuit when "Play" or "Record" is operated, and a level of –0 volts in the other positions. These levels are applied to the bottom resistor 4R35 of voltage divider 4R35/ 4R34, and 4R34 receives +12 volts. In the play position, 4TR4 will receive slightly over – 3.5 volts of negative bias in which condition it will draw no current but allow the signal at the collector to pass without hindrance. In all other positions 4TR4 will receive positive bias which will drive the transistor so that the signal at its collector will be shorted to earth potential through it.

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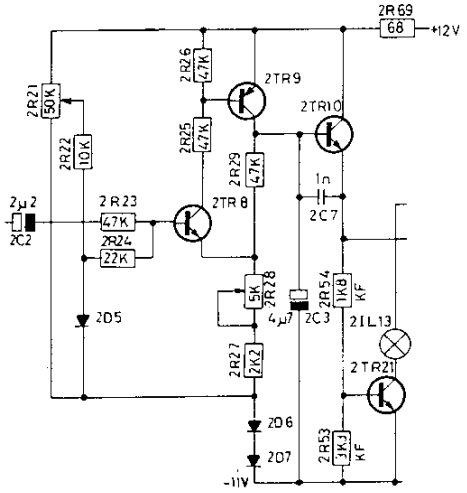
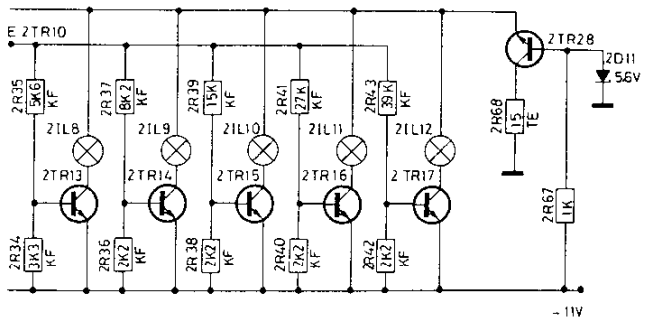


PPM

The PPM, peak program meter, may basically be divided into two parts: the sensor and indicator circuits.

The diagram above shows the sensor circuit. The AF signal from the line amplifier or recording amplifier is fed to the base of 2TR8 through 2C2 and 2R23. 2TR8 receives DC bias through its bias voltage divider, of which 2D5 is a part, so that it amplifies only the positive half-cycles of the signal. The collector resistor of 2TR8 is the bias voltage divider of 2TR9, to which the amplified half-cycles are applied; these will be proportionate to the strength of the incoming AF signal. 2TR9 will, depending on the signal amplitude, draw current through its collector resistor 2R29, 2R28, 2R27 and diodes 2D6 and 2D7. The signal is smoothed by capacitor 2C3 so that the voltage at the base of 2TR10 will be a DC voltage pulsating in time with the peak value of the AF signal. 2TR10 draws a similar pulsating current through the indicator circuit's bias voltage dividers, which combine to form the emitter resistor of 2TR10. Diodes 2D6 and 2D7 through their Zener action secure that 2TR10 is forward biased. 2R21 and 2R28 allow adjustment of the top and bottom, respectively, of the PPM. Diodes 2D5, 2D6 and 2D7 provide temperature stabilisation of the circuit, ensuring that the bias voltages of the respective transistors will decrease in the same ratio as the sensitivity of the transistors goes up as a result of temperature increases.

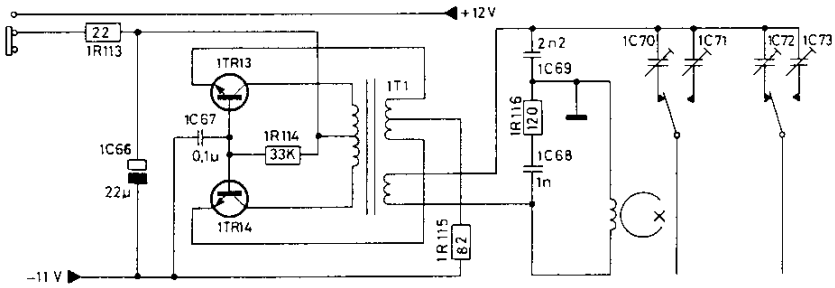
The indicator circuit is diagrammed below:



The current through the emitter of 2TR10 as mentioned above is drawn through a number of bias voltage dividers which have different division ratios. When the voltage across the bottom resistors of these dividers exceeds 0.6 V, the associated transistor will draw current, and the lamp in its collector circuit will light. The voltage dividers are calculated so that the lamps will indicate levels in steps of 5 dB except for the lamp above 0 dB, which indicates +3 dB.

Supply voltage for the lamps is obtained through 2TR28 which, by means of the 5.6 V Zener diode 2D11, ensures that the voltage across the lamps will at no time exceed 4.8 V (11 – 5.6 – 0.6 = 4.8).

Bias oscillator

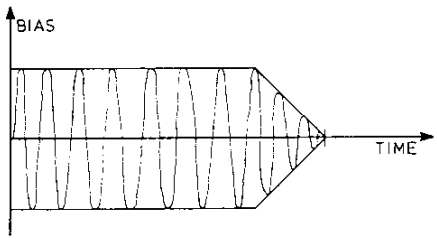


The bias oscillator is a push-pull generator using transistors 1TR13 and 1TR14. The signal is taken off inductively from the generator. The generator frequency is determined by the tuning of the tapped coil, of which also the erase head is a part. The frequency is approx. 92 kHz. Bias is fed to the record head via a pair of trimmer capacitors for CrO_2 or Fe_2O_3 as the case may be. At the recording head, the bias is mixed with the AF signal. Bias is adjusted for the two tape types with the two pairs of trimmer capacitors.

The oscillator has no direct connection to earth potential but operates between the two supply voltages of –11 volts and +12 volts; the latter supply voltage is turned off when the oscillator is not operating.

1R116 and 1C68 across the erase head suppress higher-order harmonics, especially at the erase head's self-resonance of approx. 300 kHz.

Automatic demagnetising



In the interests of optimum signal-to-noise ratio, the bias oscillator is equipped with a circuit which automatically demagnetises the combi head every time the record function is cancelled. This circuit causes the bias signal to decay slowly instead of ending abruptly at full amplitude.

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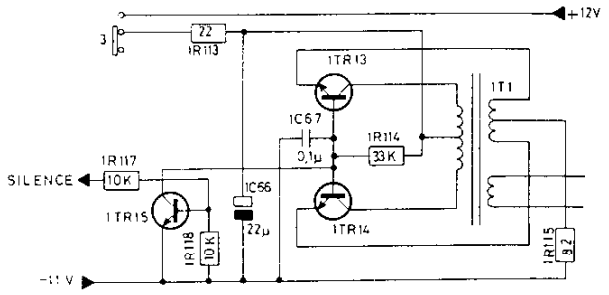
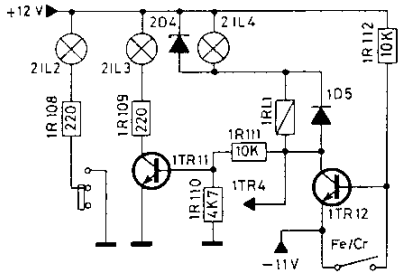


In the Record mode, the base of 1TR15 will be approx. −10.8 V, and 1TR15 is cut off.
When the Record function is cancelled, 0 V will be present on the silence wire, and 1TR15 is forward-biased. The collector of 1TR15 and hence the bases of 1TR13 and 1TR14 will carry −10.8 V. Since mechanical functions are very sluggish compared to electronic ones it will take approx. 70 msec. from the moment the voltage at the bases of 1TR13 and 1TR14 has reached −10.8 V until the +12 V supply is cut off.
With −10.8 V at the bases of 1TR13 and 1TR14 and approx. +11 V at their collectors, these two transistors are so heavily reverse-biased that their collectors will be at points of very high impedance. This causes the leads to the primary of 1T1 to float, AC-wise, causing the bias frequency amplitude to decay slowly (damped oscillation).

Automatic switch
CrO_2 – Fe_2O_3



The switch Fe/Cr, located on the rear edge of the cassette holder, is shorted when a Fe_2O_3 tape is in the holder, and open when the tape is of the CrO_2 type.

Transistor 1TR12 when the Fe/Cr switch is open will receive control current through 1R112, causing the collector of 1TR12 to be connected to −11 volts. The result is that relay 1RL1 is energised and lamp 2IL4 turns on. Relay 1RL1 switches between bias and AF recording current levels for the two tape types. Diode 2D4, in parallel with lamp 2IL4, secures that the voltage across the lamp does not exceed 5.6 volts and that relay 1RL1 can be energised even if lamp 2IL4 becomes inoperative.

Diode 1D5 protects the transistor against induction current peaks from the relay.

If the Fe/Cr switch is closed, 1TR12 will draw no current, and the potential at its collector will therefore be approx. +12 volts. This will cause 1TR11 to be driven via voltage divider 1R110/1R111 so that lamp 2IL3, which is the Fe_2O_3 indicator, turns on.

The level at the collector of 1TR12 is applied to transistors 1TR4 and 1TR9, which perform switching of equalising for right and left channels, respectively.

TECHNICAL DATA	BEOCORD 5000
Type No.	**4715**
Features	Dual capstan
	Electronic controls
	Fade function
Tape head	Sendust
Number of heads	2
Dolby system	Yes
Iron oxide tape	Yes, automatic
Chromium dioxide tape	Yes, automatic
Motors	2
Indicator system	2 Peak Programme Meters
Counter	3 digits
Stop at end of tape	Yes
Microphone	Mono/stereo
Wow and flutter, DIN	$<\pm 0.10$ %
Speed variation	$<\pm 0.5$ %
Fast forward and rewind	60 sec.
Frequency range, DIN chrom	30 – 15,000 Hz
Signal-to-noise ratio chrom	>56 dB
With Dolby + chrom	>64 dB
Erasure	>70 dB
Input radio	2.2 mV/22 kohms
Microphone	0.1 mV/2.2 kohms
AUX	300 mV/57 kohms
Output radio	940 mV/23 kohms
Headphones	Max. 2.7 V/220 ohms
Power supply	110 – 130 – 220 – 240 volts
Frequency	50 – 60 Hz
Power consumption	25 – 50 watts
Dimensions W x H x D	47 x 8 x 28 cm
Weight	8.5 kg

Subject to change without notice.

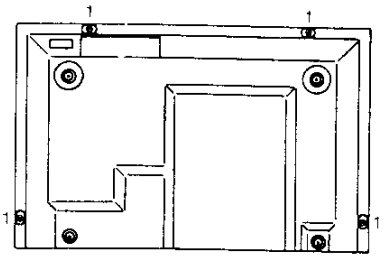
Bang&Olufsen

ADSKILLELSE
DISASSEMBLY
ZERLEGUNG

Skruerne (1) fjernes og kabinettet aftages.

Remove screws (1) and dismantle the cabinet.

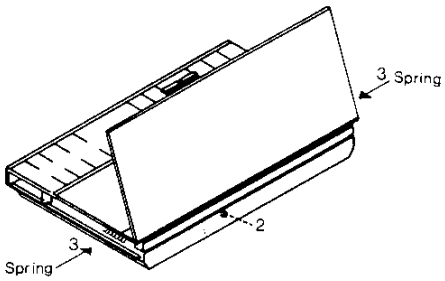
Die Schrauben (1) entfernen und das Gehäuse abnehmen.



Skruen (2) skrues ud til stop og fjedrene (3) aftages.
Den nederste topplade kan nu aftages.

Loosen screws (2) to stop and remove springs (3).
The lower top plate may now be dismanteld.

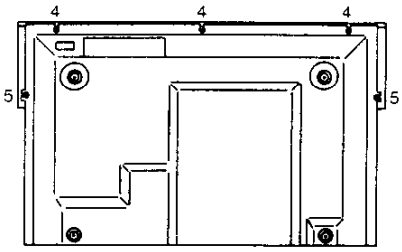
Die Schrauben (2) bis Stop lockern und die Federn (3) abnehmen.
Die untern Abdeckplatte kan jetzt entfernt werden.



Skruerne (4) løsnes og skruerne (5) fjernes.

Loosen screws (4) and remove screws (5).

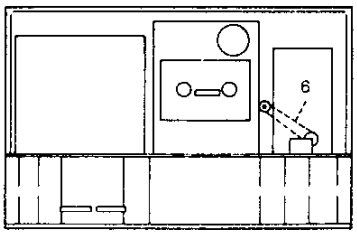
Die Schrauben (4) lockern und die Schrauben (5) entfernen.



Betjeningspanelet kan nu vippes op.
NB! PAS PÅ TÆLLEREM (6).

The operating panel may now be tipped.
NOTE! MIND THE COUNTER BELT (6).

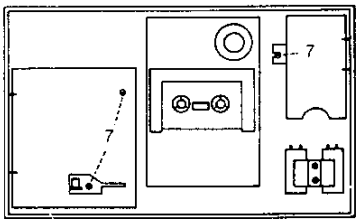
Das Bedienungspaneel kan jetzt gekippt werden.
NB! VORSICHT MIT DEM ZÄHLERRIEMEN (6).



Skruerne (7) fjernes og printpladerne er nu løse og kan stilles i serviceposition.

Remove screws (7). The PC boards are loose now and may be placed in service position.

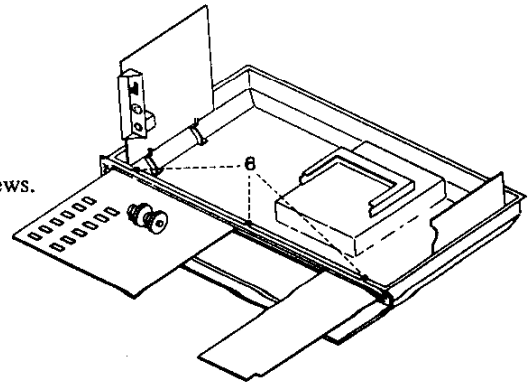
Die Schrauben (7) entfernen.
Die printplatten sind jetzt los und kann in Serviceposition angebracht werden.



Betjeningspanelet skubbes ind i hakkerne (8) og skruerne spændes.

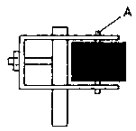
Push operating panel into dents (8) and fasten screws.

Das Bedienungspaneel in die Kerben (8) schieben und die Schrauben anziehen.



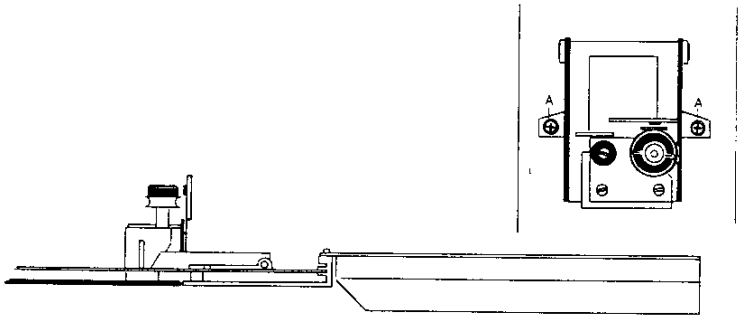
SERVICE TIPS

Thrust roller replacement



When replacing thrust roller the shaft is also to be replaced.
Pull out thrust roller shaft A, using a wire cutter or some similar tool, and fit a new thrust roller and thrust roller shaft.
Pull the right-hand thrust roller shaft out below and the left-hand one out above.
Readjust thrust roller parallelism if necessary.

Adjustment of counter



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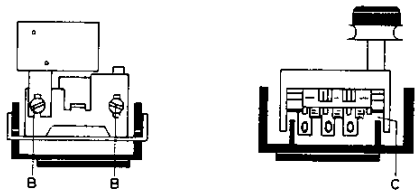
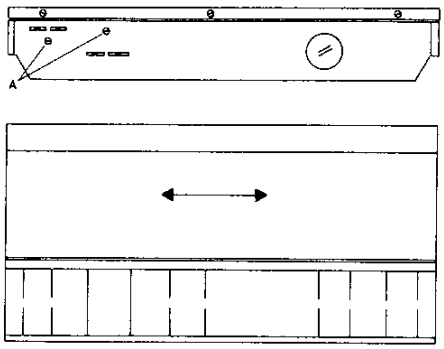
Push the cover plate into the guideway on the control panel, holding it parallel with the PC board.
Loosen screws A and push the counter into place in the hole on the cover plate.
Tighten screws A.



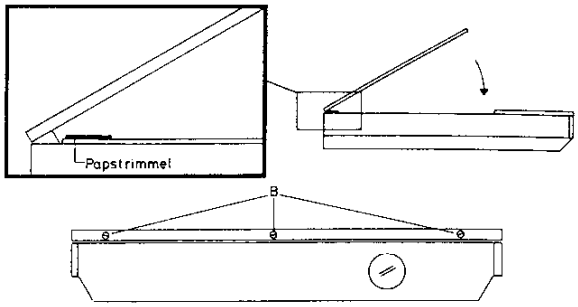
Loosen screws B.
Slide the counter housing up and down until spacing C (between reset button and counter) is not less than 1 mm and reset the counter by pressing the counter window.
Tighten screws B.

Adjustment of cover, sideways



Loosen screws A on the rear of the unit and push the cover sideways in the direction of the arrow until the cover is symmetrical with the control panel.
Tighten screws A.

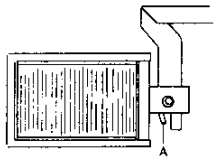
Height



Loosen screws B.
Put a cardboard strip 1 mm thick and approx. 2 cm wide in between the dust cover and cover plate.
Close the dust cover and with care press it down against the cover plate at both front and rear.
Tighten screws B.

Replacement of belt, pos. 119

References apply to pos. nos. on page 4-3.
Take off locking rings 153 and 201.
Take off right and left thrust roller arms.
Take off arm for springs 110 (in both sides).
Take off locking ring 103 and tubular rivet 93 (in both sides).
Take off screws and spacers 111,109,126,128 and 129.
Take off cassette holder.
Take off springs 260 (in both sides) from the notches in the tape mechanism.
Put marks where the springs are to be.
Take off screw 253.
Take off locking ring 117, cord pulley 116 and belt 115.
With care bend the fork arm on chassis 261 (junction of chassis and magnet coil 246 until chassis 261 can be taken off.
Take off lamp socket 105.
Belt 119 can now be replaced.
Reassemble the tape mechanism, proceeding in the reverse order.



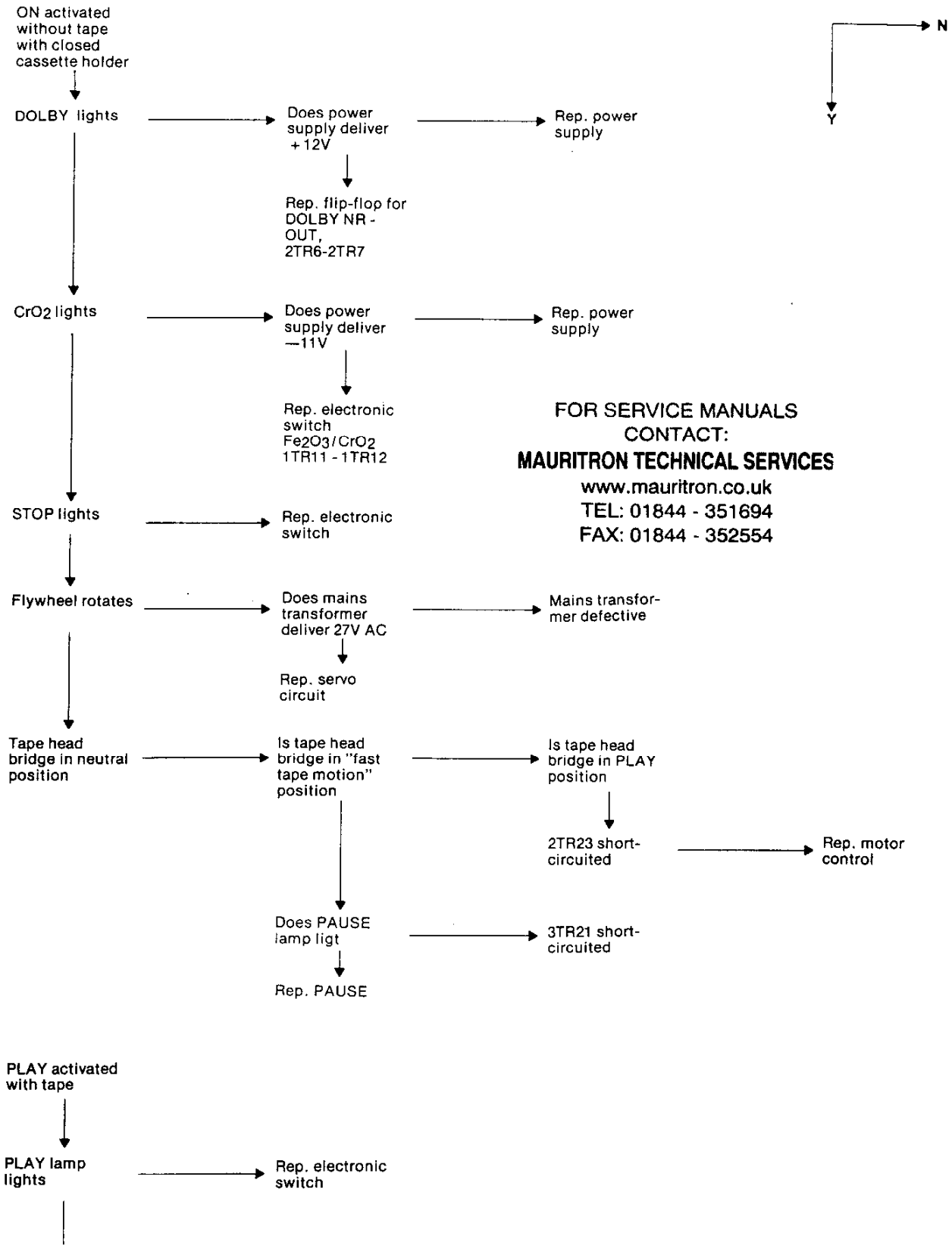
After having assembled the tape mechanism, make the following check on the depth of insertion:
Activate Play.
Bend fork arm on chassis 261 at point A until chassis 261 reaches all the way forward to angle 122.
Check that the magnet coil armature is driven fully home.
Check azimuth and eject adjustments.

IS 12 glue No. 3980033

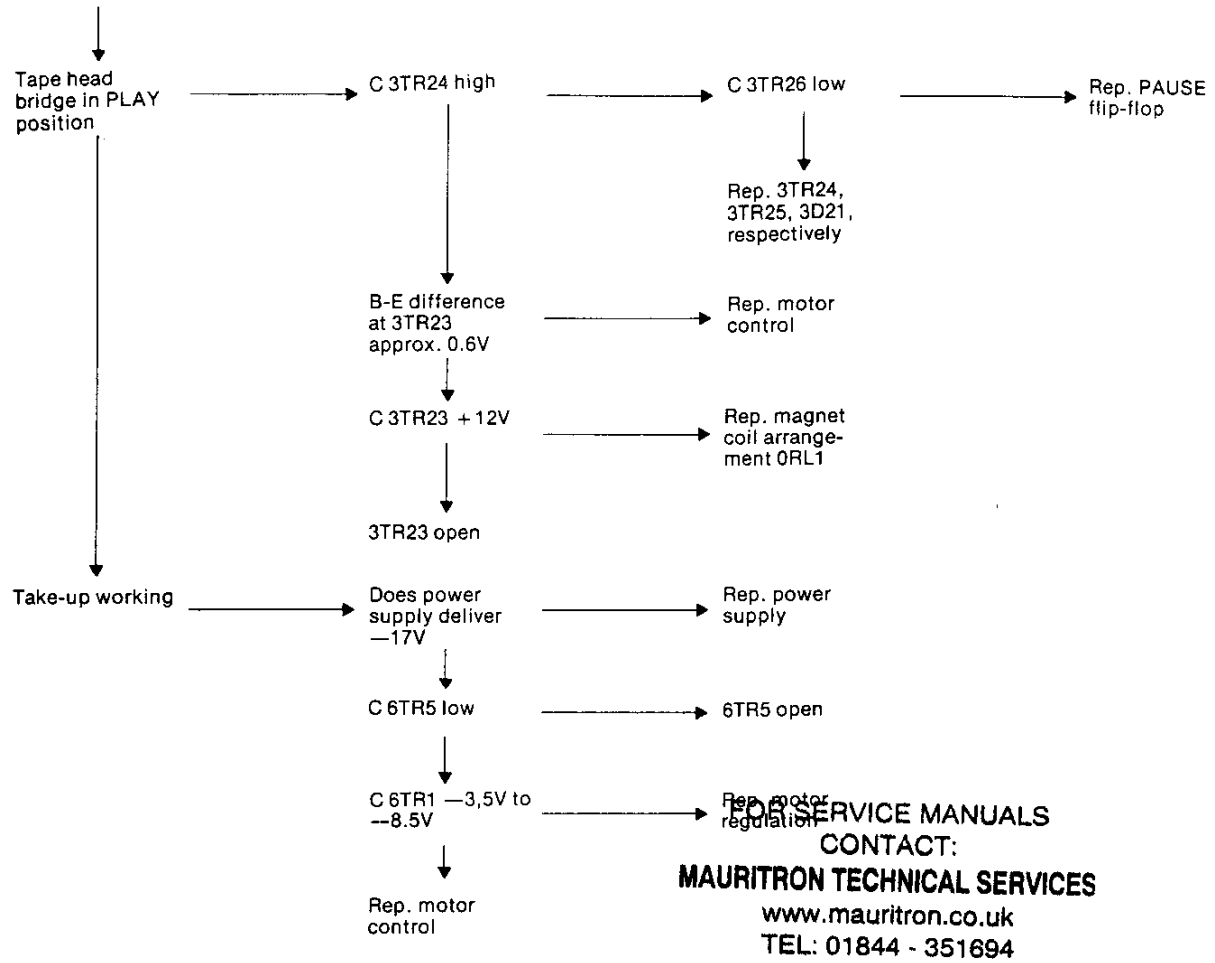
IS 12 should be kept at temperatures between 4^0 C and 8^0 C.
Bring bottle to room temperature before opening it.
Pointed screw for tape heads: Index No. 2070905.

FAULT FINDING

Below, high should be regarded as a negative level with respect to chassis potential.



FOR SERVICE MANUALS
CONTACT:
MAURITRON TECHNICAL SERVICES
www.mauritron.co.uk
TEL: 01844 - 351694
FAX: 01844 - 352554



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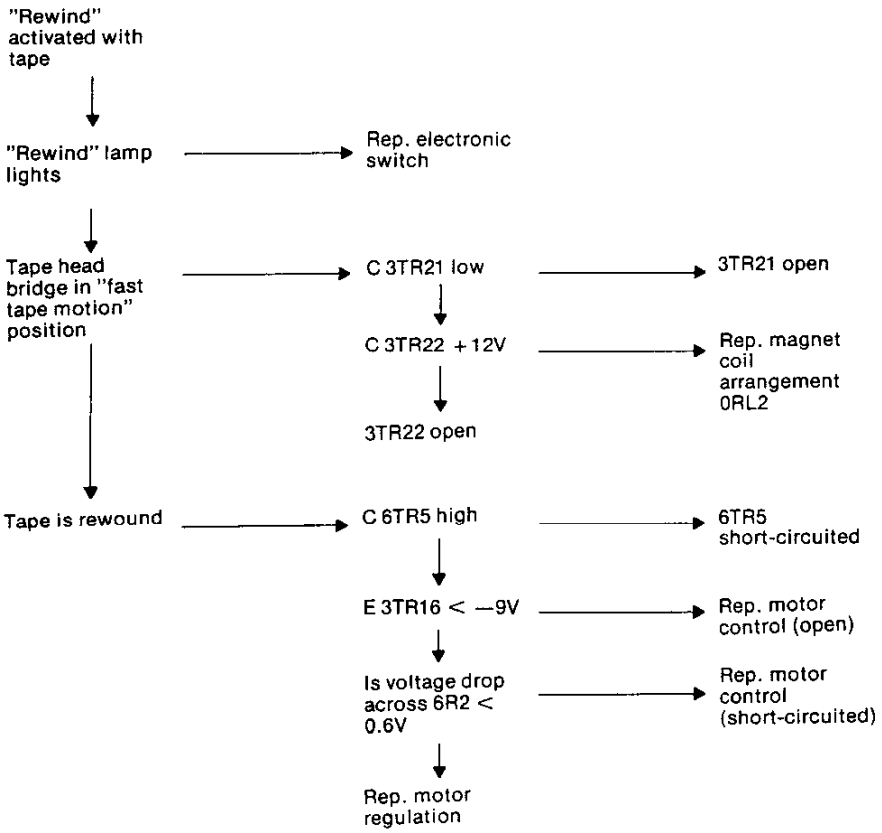
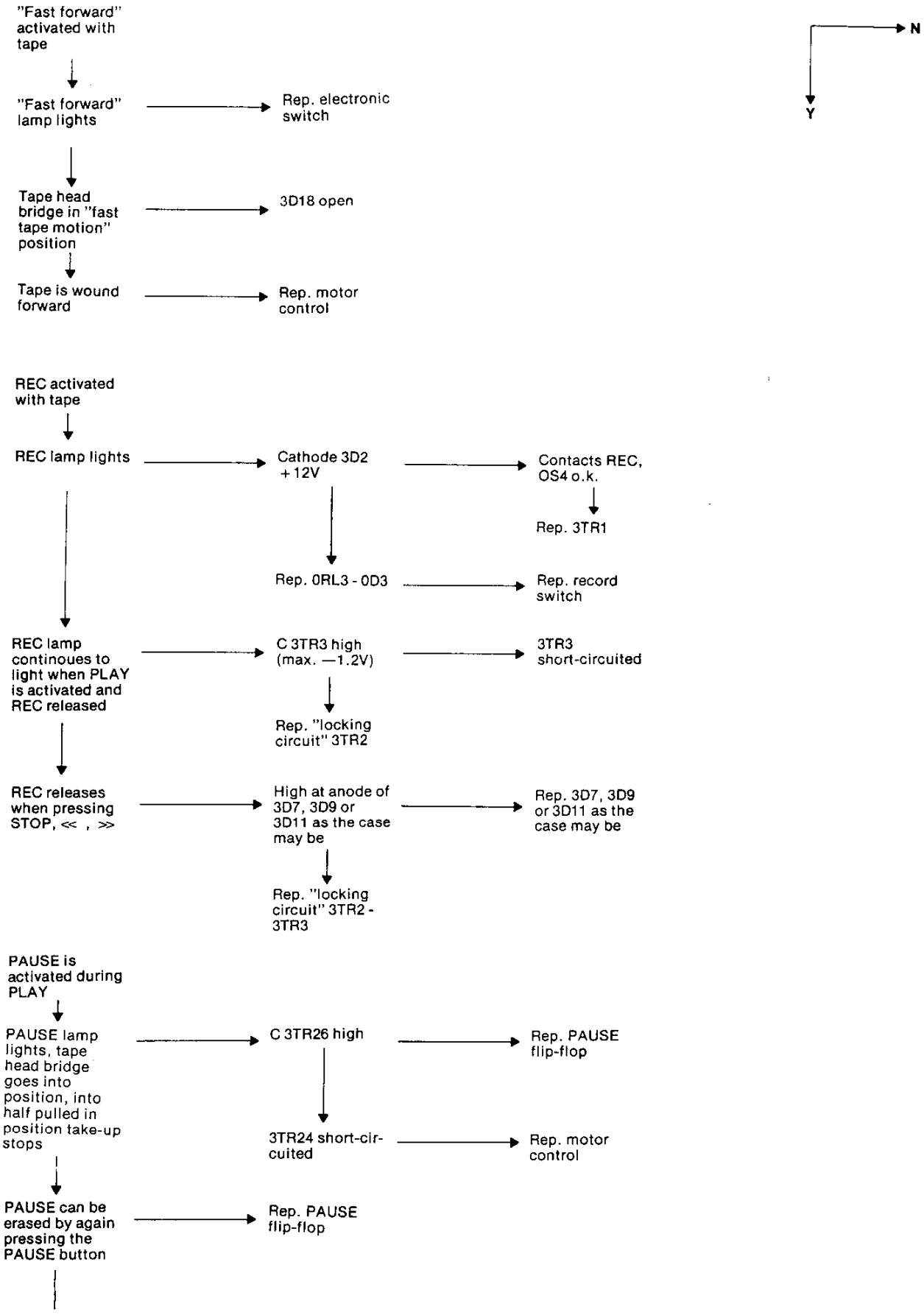
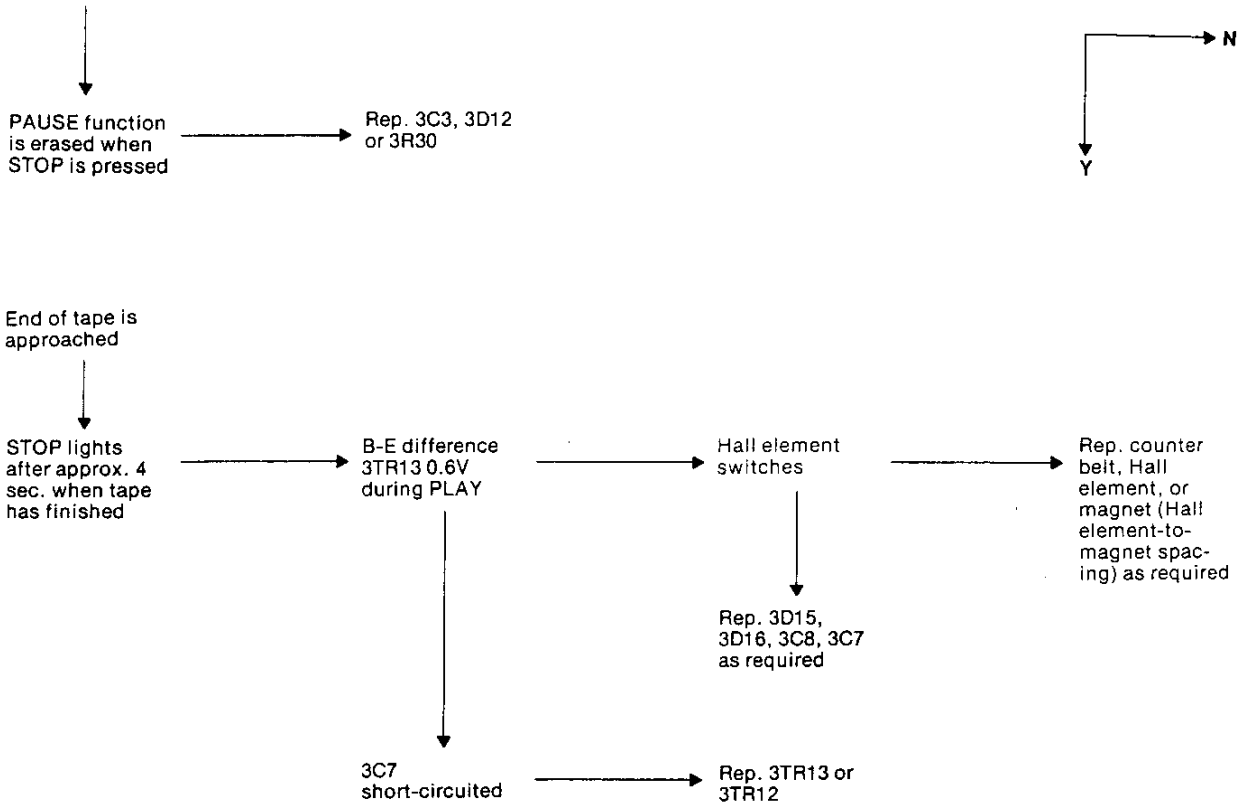



"Fast forward" activated with tape
"Fast forward" lamp lights
Rep. electronic switch
Tape head bridge in "fast tape motion" position
3D18 open
Tape is wound forward
Rep. motor control
N
Y
REC activated with tape
REC lamp lights
Cathode 3D2 +12V
Contacts REC, OS4 o.k.
Rep. 3TR1
Rep. 0RL3 - 0D3
Rep. record switch
REC lamp continoues to light when PLAY is activated and REC released
C 3TR3 high (max. —1.2V)
3TR3 short-circuited
Rep. "locking circuit" 3TR2
REC releases when pressing STOP, << , >>
High at anode of 3D7, 3D9 or 3D11 as the case may be
Rep. 3D7, 3D9 or 3D11 as the case may be
Rep. "locking circuit" 3TR2 - 3TR3
PAUSE is activated during PLAY
PAUSE lamp lights, tape head bridge goes into position, into half pulled in position take-up stops
C 3TR26 high
Rep. PAUSE flip-flop
3TR24 short-circuited
Rep. motor control
PAUSE can be erased by again pressing the PAUSE button
Rep. PAUSE flip-flop


PAUSE function is erased when STOP is pressed
Rep. 3C3, 3D12 or 3R30
N
Y
End of tape is approached
STOP lights after approx. 4 sec. when tape has finished
B-E difference 3TR13 0.6V during PLAY
Hall element switches
Rep. counter belt, Hall element, or magnet (Hall element-to-magnet spacing) as required
Rep. 3D15, 3D16, 3C8, 3C7 as required
3C7 short-circuited
Rep. 3TR13 or 3TR12

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